LMS/LEH/S05822-0.0

Remedial Design/Remedial Action Work Plan for the Former Laboratory for Energy-Related Health Research Federal Facility University of California, Davis

November 2010

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Abbreviations

ARAR	applicable or relevant and appropriate requirement
BBL	Blasland, Bouck, and Lee
C-14	carbon-14
CEL	CalScience Environmental Laboratories, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Co-60	cobalt-60
COC	constituent of concern
CRWQCB	California Regional Water Quality Control Board, Central Valley Region
Cs-137	cesium-137
DI	deionized
DO	dissolved oxygen
DOE	U.S. Department of Energy
DQO	data quality objectives
DSS	Domestic Septic System
DTSC	California Department of Toxic Substances Control
EDPs	Eastern Dog Pens
EPA	U.S. Environmental Protection Agency
ft	feet
GEL	GEL Laboratories
HSU	hydrostratigraphic unit
ID	identification
LEHR	Laboratory for Energy-Related Health Research
LTS&M	long-term surveillance and maintenance
MCL	maximum contaminant level
NTU	nephelometric turbidity unit
ORP	oxidation-reduction potential
QAPP	Quality Assurance Project Plan
Ra/Sr	radium/strontium
Ra-226	radium-226
ROD	Record of Decision
SC	specific conductance
SOP	standard operating procedure

Sr-90	strontium-90
SWT	Southwest Trenches
TestAmerica	TestAmerica Laboratories
UC Davis	University of California, Davis
WDPs	Western Dog Pens
Weiss	Weiss Associates

1.0 Introduction

The objective of this Remedial Design/Remedial Action Work Plan is to document the requirements and methods for implementing remedies selected in the Record of Decision (ROD) (DOE 2009b) for the U.S. Department of Energy (DOE) areas of the Laboratory for Energy-Related Health Research (LEHR). The selected remedies are intended to monitor and control residual contamination at the site. Provided in this report are procedures to implement the selected remedies listed in Table 1–1, which include:

- Land-use restrictions, including a Soil Management Plan (Appendix A), and a prohibition of residential use,
- Long-term groundwater monitoring, and
- Contingency remediation.

Table 1–1. Selected Remedies for Each DOE Area

DOE Area	No Action/No Further Action	Long-Term Groundwater Monitoring/Contingency Remediation	Land-Use Restrictions	
			Soil Management Plan	No Residential Use
Radium/Strontium Treatment Systems (includes Domestic Septic System 2)		✓	✓	
Domestic Septic System 1	✓			
Domestic Septic System 3		✓	✓	
Domestic Septic System 4		✓	✓	✓
Domestic Septic System 5	✓			
Domestic Septic System 6	✓			
Domestic Septic System 7	✓			
DOE Disposal Box	✓			
Dry Wells A–E		✓	✓	
Eastern Dog Pens			✓	
Southwest Trenches		✓	✓	
Western Dog Pens	✓			

1.1 Site Description

LEHR is a former research facility that DOE operated at the University of California, Davis (UC Davis). The LEHR Federal Facility is defined in a Federal Facility Agreement signed in 1999 by DOE and the U.S. Environmental Protection Agency (EPA). The California Department of Public Health (formerly the California Department of Health Services) and the California Regional Water Quality Control Board, Central Valley Region, (CRWQCB) joined as signatories in 1999, and the California Department of Toxic Substances Control (DTSC) joined in 2000. The LEHR Federal Facility comprises the land and improvements within the former LEHR Facility boundary shown in Figure 1–1, including the following areas:

- All LEHR buildings;
- The Cobalt-60 (Co-60) Irradiation Field;

- The Radium/Strontium (Ra/Sr) Treatment Systems area;
- Seven septic tanks (including leach fields and dry wells);
- The Southwest Trenches (SWT) area;
- The Western Dog Pens (WDPs) area;
- The Eastern Dog Pens (EDPs) area;
- The DOE Disposal Box; and
- Areas where contamination originating from the areas listed above is located, excluding areas assigned to UC Davis, by a Memorandum of Agreement between the Regents of the University of California and DOE (DOE 2009a).

1.2 Applicable Terminology

The following terminology is used in this and other documents contained in the LEHR Administrative Record to refer to various areas of the site:

- LEHR Site—As defined in the Federal Facility Agreement, the area referred to on the National Priorities List as "LEHR/Old Campus Landfill."
- DOE areas—Portions of the LEHR Federal Facility (defined in Section 1.1) where Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or California groundwater protection standards are exceeded (i.e., the SWT area, the Ra/Sr Treatment Systems area, Domestic Septic Systems (DSSs) 3 and 4, Dry Wells A–E, and the EDPs area) (Figure 1–2).
- UC Davis areas—Portions of the LEHR Site that include Landfill Disposal Units 1, 2, and 3; the 49 waste burial holes; the eastern and southern disposal trenches; and groundwater impacted by UC Davis's activities. (Figure 1–2).

1.3 Location

LEHR is immediately east of Old Davis Road, about 2,500 feet (ft) south of U.S. Interstate 80 in Solano County, California, in the southeast quarter of Section 21, Township 8 North, Range 2 East, Mount Diablo Base and Meridian (Figure 1–1). The former LEHR facility (Figure 1–2) is on the southern portion of Solano County Assessor's Parcel No. 110-05-04. It is approximately 1.5 miles south of the city of Davis, in the southeast portion (South Campus Area) of the UC Davis campus.

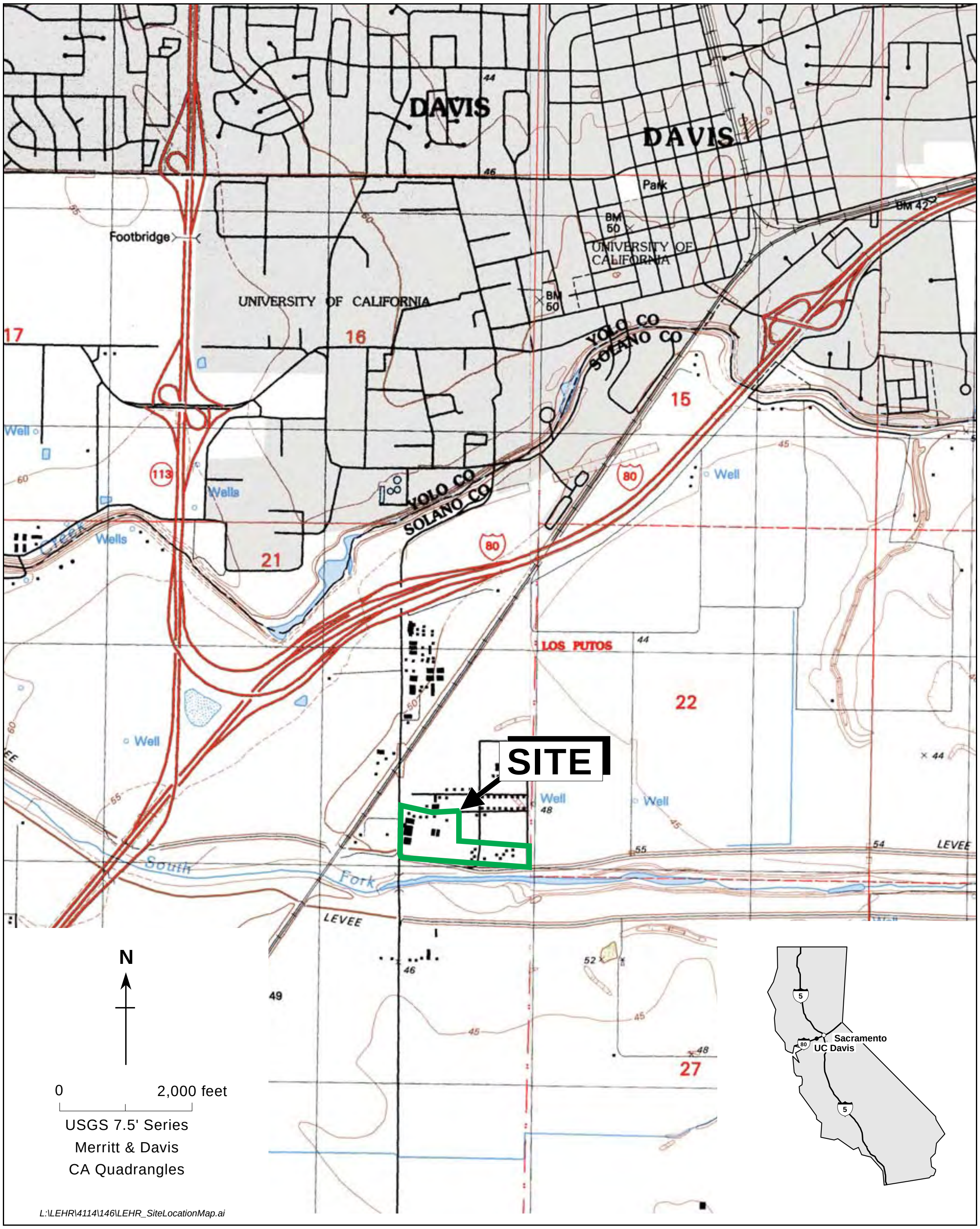

Figure 1–1. Location of the LEHR Site, UC Davis, Solano County, California

Figure 1–2. LEHR Site Features

1.4 Operational History

The U.S. Atomic Energy Commission first sponsored radiological studies on laboratory animals at UC Davis in the early 1950s. Initially on the main campus, LEHR was moved to its present location in 1958 (Figure 1–1). Research at LEHR through the late 1980s was focused on health effects from chronic exposure to radionuclides, primarily strontium-90 (Sr-90) and radium-226 (Ra-226), using beagles as research subjects. Other related research was conducted at the site concurrently with these long-term studies. In the early 1970s, a Co-60 irradiator facility was constructed at the site to study the effects of chronic exposure to gamma radiation on humans, again using beagles.

A campus landfill with two waste burial units used from the 1940s until the mid-1960s is at the site (Figure 1–2). Several low-level radioactive-waste burial areas were also at the site, and campus and LEHR research waste was buried in these areas until 1974 in accordance with regulations in effect at the time. The principal environmental threats posed by contaminant releases associated with LEHR activities have been mitigated during several removal actions conducted at the site since 1996.

All DOE-funded research activities at LEHR ceased by 1988, and in the same year, pursuant to the Memorandum of Agreement between DOE and the Regents of the University of California, DOE's Office of Energy Research initiated activities to close out the research program at LEHR.

1.5 Cleanup History

In May 1994, EPA placed the LEHR/Old Campus Landfill on the National Priorities List (Superfund Site Identification No. CA2890190000) because contamination at the site was considered to pose significant risk to human health and the environment. From 1975 to 2009, DOE decontaminated and decommissioned aboveground structures and performed the following removal actions:

- In 1975, gravel and curbing were removed from 64 pens in the WDPs.
- In 1995, DOE demolished the Imhoff Wastewater Treatment Facility (Figure 1–2) as a voluntary removal action.
- In 1995 and 1996, concrete pedestals and wooden barrels were removed from the EDPs and WDPs and disposed of as low-level radioactive waste at the Hanford Site in Washington (Weiss 1997).
- In 1996, IT Corporation removed the pedestals from the WDPs and EDPs and collected soil and gravel data during the removal activities (Weiss 1997).
- Before 1997, DOE decommissioned, decontaminated, and released for unrestricted use four of the 17 buildings associated with the LEHR Federal Facility that did not meet the release criteria of DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (the Animal Hospital 1 building, the Animal Hospital 2 building, the Specimen Storage building, and the Co-60 building) (Figure 1–2). A notice of certification of the radiological condition of this real property was published in the *Federal Register* on October 3, 1997 (62 FR 51844–51845).

- In 1996, Weiss Associates (Weiss) conducted a time-critical removal action at the DOE Disposal Box area.
- In 1998, Weiss conducted a non-time-critical removal action at the SWT area.
- In 1999 and 2000, Weiss conducted a non-time-critical removal action at the Ra/Sr Treatment Systems area. DSS 2, which was associated with the Ra/Sr Treatment System, parts of DSS 1, and the DSS 5 leach field and parts of Dry Wells A–E were also removed (Figure 1–2).
- In 2001, Weiss conducted a non-time-critical removal action in the WDPs area.
- In 2002, Weiss conducted a non-time-critical removal action in the DSS 3 and 6 areas.
- In 2007, DOE removed and disposed of concrete from the EDPs.

Human health risks were below 1 in 1 million, and ecological risks were insignificant at DSS 7, so no removal action was performed, and no further action is required for this area.

A risk assessment at the DOE Disposal Box conducted after the completion of the removal action in this area (Weiss 2005) showed that no risk to human health, ecological receptors, or groundwater quality remained in the area; hence, no further action is required in the DOE Disposal Box. A risk assessment performed after the four non-time-critical removal actions in the SWT; Ra/Sr Treatment Systems; DSS 1, 2, 3, 5, and 6 and Dry Wells A–E; and WDPs areas showed that excess risk to human health from contaminants in all of these areas, except for the SWT area, was reduced to below 1 in 1 million (Weiss 2005), and ecological risks were insignificant after the removal actions (BBL 2006). Risks to human health were above 1 in 1 million at DSS 4 and the EDPs (Weiss 2005), but ecological risks were insignificant (BBL 2006).

Table 1–2 summarizes risks for all DOE areas where the risk remains above 1 in 1 million. The potential remains for future groundwater impacts from residual contaminants in vadose zone soil at the SWT, Ra/Sr Treatment Systems, Dry Wells, and DSS 3 and 4 areas, as discussed below. No further action is required at the WDPs and DSSs 1, 2, 5, 6, and 7.

1.6 Selected Remedies for DOE Areas

As described in detail in the risk characterization report for DOE areas (Weiss 2005), constituents of concern (COCs) for each area were selected based on their presence in soil at levels statistically above background and: (1) their presence at levels that were shown (by multiple lines of evidence) to present human health cancer risks above 1 in 1 million, and/or (2) their potential to impact groundwater above background levels. As discussed above and shown in Table 1–1, the SWT, DSS 4, and EDPs areas presently require additional actions (Weiss 2005) because residual COCs are present at these areas at concentrations above remediation goals.

Table 1–3 lists the COCs at each DOE area identified as presenting potential human health cancer risks exceeding 1 in 1 million. As described in *Final DOE Areas Feasibility Study* (Weiss 2008), the remediation goals for these COCs represent a 1 in 1 million cancer risk.

Table 1–4 presents groundwater quality goals developed in conformance with the CRWQCB Central Valley Region's guidance document *Designated-Level Methodology for Waste Classification and Cleanup Level Determination* (CRWQCB 1989). These remediation goals represent contaminant concentrations in soil that, based on modeling, would not contaminate groundwater above groundwater background levels or water quality goals. Residual soil contamination exceeding these goals remains at the SWT, Ra/Sr Treatment Systems, Dry Wells, and DSS 3 and 4 areas, and groundwater monitoring beneath and downgradient of these areas of contamination will continue until it can be shown that the wastes no longer threaten water quality.

Table 1–5 lists additional COCs that were identified as possibly having a small impact on groundwater in the future based on the analysis presented in the risk characterization report (Weiss 2005). As shown on the table, the areas where these constituents were identified are the SWT, Ra/Sr Treatment Systems, EDPs and DSS 1, 3, 4, 5, and 6 areas. Groundwater at the site shall be monitored for these constituents.

Table 1–2. Human Health Risks by Exposure Route for Contaminants in Soil at the DOE Areas

		Cancer Risk by Exposure Route							
DOE Area	**Receptor/Constituent**	**Exposure Point Concentration (0–10 ft)[a]**	**Soil Ingestion**	**Soil Dermal Exposure**	**Aboveground Plant Ingestion[b]**	**Belowground Plant Ingestion[b]**	**External Radiation**	**Dust Inhalation**	**Total Cancer Risk**
Domestic Septic System 4	**On-Site Resident**								
	Benzo(a)anthracene	3.8	4.E-06	1.E-06	9.E-06	1.E-06	NA	3.E-10	2.E-05
	Benzo(a)pyrene	2.4	3.E-05	7.E-06	3.E-05	5.E-06	NA	2.E-09	7.E-05
	Benzo(b)fluoranthene	2.7	3.E-06	8.E-07	3.E-06	5.E-07	NA	2.E-10	7.E-06
	Benzo(k)fluoranthene	1.5	3.E-06	7.E-07	3.E-04	5.E-05	NA	7.E-11	4.E-04
	Dibenzo(a,h)anthracene	1.1	7.E-06	2.E-06	4.E-06	6.E-07	NA	5.E-10	1.E-05
	Indeno(1,2,3-cd)pyrene	0.86	2.E-06	4.E-07	1.E-06	1.E-07	NA	4.E-11	4.E-06
	Total								**5.E-04**
	On-Site Construction Worker								
	Benzo(a)pyrene	2.4	8.E-07	3.E-07	NA	NA	NA	7.E-10	**1.E-06**
Eastern Dog Pens	**On-Site Resident**								
	Dieldrin	0.019	5.E-07	9.E-08	2.E-06	2.E-07	NA	4.E-11	3.E-06
	Strontium-90	0.33[c]	4.E-08	NA	1.E-06	NA	5.E-08	5.E-13	1.E-06
	Total								**4.E-06**
Southwest Trenches	**On-Site Resident**								
	Strontium-90	0.94	1.E-07	NA	3.E-06	NA	2.E-07	2.E-12	**3.E-06**

Notes:
Source data from the *Revised LEHR/SCDS Site-Wide Risk Assessment*, Tables 7 and 8 (UC Davis 2004a). Constituents and risks are presented here if (a) the constituent is present above site background and if (b) the constituent contributes at least a factor of 1 in 1 million, or greater than 10 percent, to the excess cumulative cancer risk for a DOE area and receptor. Only exposure pathways for contaminants in soil at the DOE areas are presented here. Exposures to groundwater and surface water contaminants are not included, as they are being addressed by the UC Davis Feasibility Study.
[a] The 95 percent upper confidence limit on the mean or maximum sample concentration. Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
[b] Homegrown produce. For radionuclides, plant ingestion is not subdivided into aboveground and belowground produce.
[c] Exposure point concentration after Eastern Dog Pens maintenance action.

Abbreviations:
NA = not applicable

Table 1–3. Remediation Goals for the Protection of Human Health

DOE Area	Receptor/Constituent of Concern	Exposure Point Concentration[a]	Remediation Goal[b]
Domestic Septic System 4	On-Site Resident		
	Benzo(a)anthracene	3.8	0.2
	Benzo(a)pyrene	2.4	0.03
	Benzo(b)fluoranthene	2.7	0.4
	Benzo(k)fluoranthene	1.5	0.004
	Dibenzo(a,h)anthracene	1.1	0.1
	Indeno(1,2,3-cd)pyrene	0.86	0.2
	On-Site Construction Worker		
	Benzo(a)pyrene	2.4	2
Southwest Trenches	On-Site Resident		
	Strontium-90+daughter	0.94	0.3
Eastern Dog Pens	On-Site Resident		
	Dieldrin	0.019	0.006
	Strontium-90+daughter	0.33[c]	0.3

Notes:
[a] Maximum concentration or 95 percent upper confidence limit on the mean for soil located between 0 and 10 ft below ground surface.
[b] Remediation Goals based on 1 in 1 million risk, determined using one significant figure total cancer risk. All concentrations are based on dry weight of soil sample. Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
[c] Exposure point concentration after Eastern Dog Pens maintenance action.

Table 1–4. Soil Remediation Goals for the Protection of Groundwater

DOE Area	Constituents of Concern in Soil[a]	Maximum Soil Concentration[b]	Background Remediation Goal[c]	MCL Remediation Goal[d]
Domestic Septic System 3	Formaldehyde	2.2	0.00378	0.0151[f]
	Molybdenum	2.5	<0.26[e]	3.11[g]
	Nitrate	106	36[e]	36[e]
Domestic Septic System 4	Selenium	2.0[g]	4.0	35
Dry Wells A–E Area	Chromium	245	181[e]	181[e]
	Hexavalent Chromium	1.62	1.3[e]	1.3[e]
	Mercury	5.3	0.63[e]	0.63[e]
	Molybdenum	1.3	0.30	3.6[g]
	Silver	53.8	0.55[e]	0.83
	Cesium-137	0.191	0.1	20[i]
	Strontium-90	0.176	0.0595	0.28
Radium/Strontium Treatment Systems	Nitrate	304	36[e]	36[e]
	Carbon-14	2.41	0.13[e]	2.34[I,j]
	Radium-226	1.72[k]	0.752[e]	1.9
Southwest Trenches	Nitrate	909	36[e]	36[e]
	Carbon-14	5.84	0.13[e]	0.292[I,j]

Notes:
Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
MCL = maximum contaminant level
[a] Vadose zone soil contaminant with potential to impact groundwater.
[b] Maximum level of the specified constituent detected in soil samples collected from the specified DOE area.
[c] Soil concentration predicted by transport modeling above which groundwater impacts in excess of site background are possible. The calculated remediation goals are expressed as dry weight.
[d] Soil concentration predicted by transport modeling above which groundwater impacts above California drinking water MCL may occur, unless noted. The calculated remediation goals are expressed as dry weight.
[e] Soil background concentration was selected as the remediation goal because the calculated remediation goal is below soil background concentration. Calculated remediation goals are presented in the *Site-Wide Risk Assessment* for DOE areas (Weiss 2005).
[f] Based on the California Department of Public Health Notification Level of 100 micrograms per liter (*California Health and Safety Code* 116455).
[g] Based on the EPA Region 9 preliminary remediation goal for tap water (EPA 2010).
[h] Residual selenium soil concentrations exceeded soil background in 23 percent of the samples collected, and modeling suggests that selenium concentrations in the soil are unlikely to impact groundwater at levels exceeding the remediation goals. However, selenium was retained as a constituent of concern due to its presence (one result) in a downgradient hydrostratigraphic unit (HSU)-1 well at a concentration slightly above groundwater background.
[i] Based on the 4-millirem-per-year federal maximum contaminant level for beta particles and photon emitters (EPA 2000).
[j] The different maximum contaminant level remediation goals for the Ra/Sr Treatment Systems and SWT areas reflect the observed vertical distribution of contamination in these areas.
[k] The sample containing the maximum radium-226 result in the Ra/Sr Treatment Systems area was re-collected and reanalyzed. The reported maximum value is the average of the initial result (1.81 picocuries per gram) and re-collected sample result (1.63 picocuries per gram).

Table 1–5. Additional Constituents to be Monitored due to Potential Impact on Groundwater Quality

Area	Constituents of Potential Concern to Be Monitored
Domestic Septic System 1	Aluminum
Domestic Septic System 3	Aluminum, Silver
Domestic Septic System 4	Aluminum, Chromium, Nickel
Domestic Septic System 5	Aluminum
Domestic Septic System 6	Aluminum
Domestic Septic System 7	None
Dry Wells A–E	None
Radium/Strontium Treatment Systems	Americium-241
Southwest Trenches	Mercury, Zinc
Western Dog Pens	None
Eastern Dog Pens	Alpha-Chlordane, Gamma-Chlordane, Dieldrin
DOE Disposal Box	None

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2.0 Implementation of Land-Use Restrictions

Land-use restrictions are physical, administrative, or legal mechanisms used to limit exposure to residual contamination, and they are often applied when a site is not remediated to a level that would allow for its unrestricted use. The land-use controls for DOE areas are:

- Access to areas identified on Figure 2−1 for the purpose of collecting samples and maintaining groundwater monitoring wells;
- Prohibition against interference with the groundwater monitoring system;
- Implementation of a Soil Management Plan in all DOE areas listed in Table 1−1, except areas where No Action or No Further Action was identified;
- Prohibition against residential and agricultural use of the DSS 4 area.

Land-use restrictions at the DOE areas at LEHR shall:

- Prevent exposure to contaminated soil,
- Prevent the improper disposal of contaminated soils,
- Maintain the integrity of all present and future monitoring wells required for groundwater monitoring,
- Prevent the groundwater monitoring wells from being tampered with or destroyed,
- Provide EPA and DTSC reasonable right of entry and access to the property for periodic inspections to ensure compliance with land-use restrictions,
- Prohibit residential or agricultural use at DSS 4, and
- Prohibit the reuse of site soil from areas subject to land-use controls outside of the site boundary for any purpose without DTSC's and EPA's written approval.

These controls will be maintained until the concentrations of contaminants in the soil are at levels that allow unrestricted use (see remediation goals in Tables 1–3 and 1–4). These controls, except for the residential use restriction and access requirements, shall be implemented through the Soil Management Plan (Appendix A).

Any activity that is inconsistent with the objectives of these land-use controls or use restrictions, or any other action that may interfere with the effectiveness of these land-use controls or use restrictions will be addressed by DOE as soon as practicable. The process to remedy any action that may interfere with land-use controls will be initiated no later than 10 days after DOE becomes aware of such action.

2.1 Areas Subject to Land-Use Restrictions

Figure 2−1 shows the location of areas subject to land-use restrictions. The Soil Management Plan provides soil sample locations and analytical results that can be used to evaluate in detail the lateral and vertical extent of the contamination in each area. The lateral extent of the areas subject to land-use restrictions shall be confirmed by a survey. Figures or other descriptions of the areal extent of the residual contamination shall be included with the land-use covenants to be

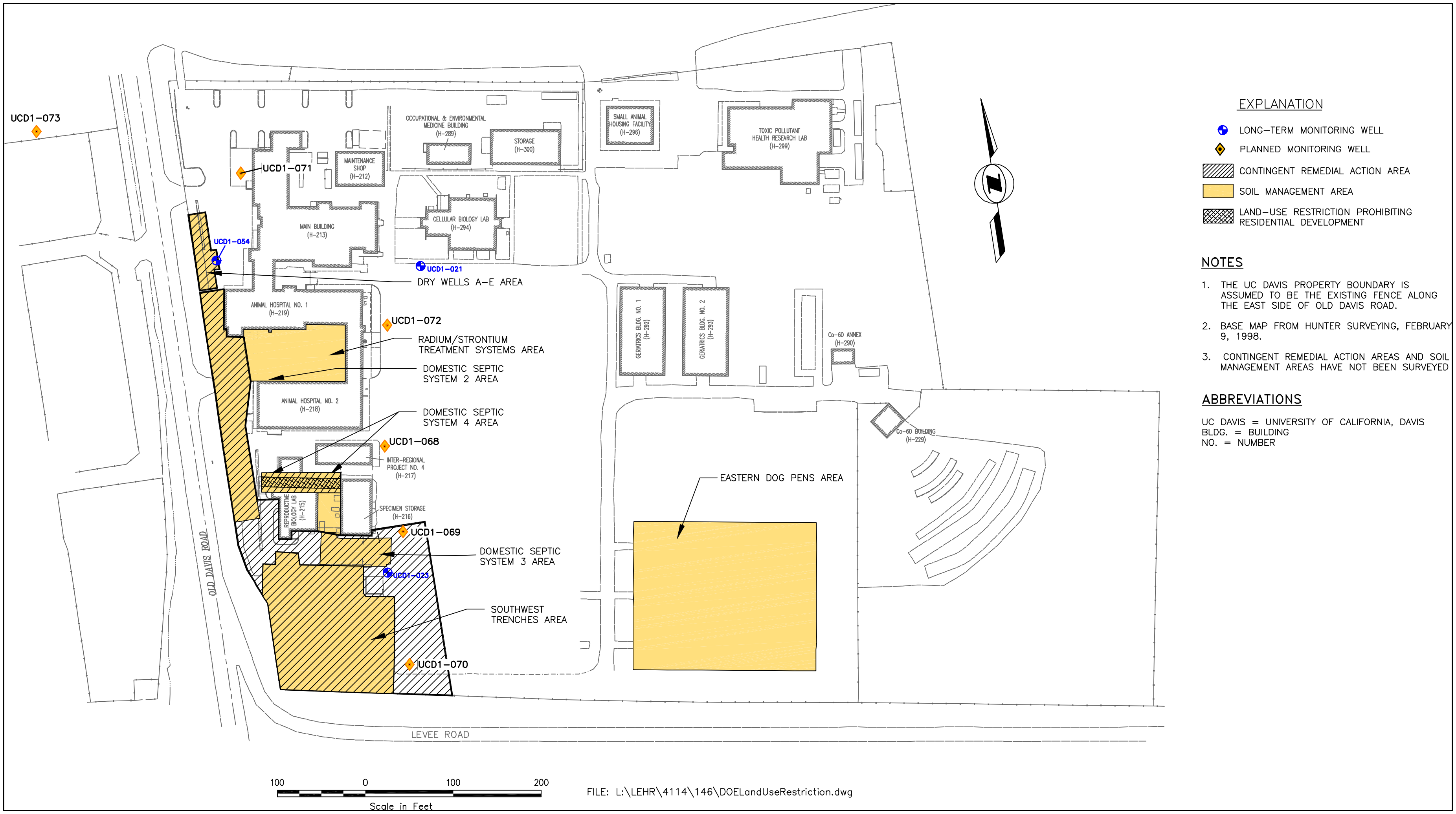

Figure 2–1. DOE Areas of the LEHR Federal Facility Subject to Land-Use Controls

recorded. Any changes to the recorded documents shall be approved by the regulatory agencies who are signatories to the ROD (DOE 2009b).

2.1.1 Land Survey

A professional land surveyor licensed by the California Board for Professional Engineers and Land Surveyors will survey areas subject to land-use restrictions and will develop a certified survey map and a legal description, which shall be recorded as discussed in Section 2.2 below. The basis for the location of the areas to be surveyed will be the native AutoCAD version of Figure 2−1. All survey work shall conform to the accepted standards of the engineering profession (ALTA/ACMS 2005). The surveys shall meet the following requirements:

- The accuracy of all boundary surveys done in connection with this project shall have a precision of 1 in 10,000.
- A map shall fully and clearly show and identify such monuments or other evidence determining the boundaries of the site as were found on the ground, together with sufficient corners of adjoining property, tract numbers, and place of record; by section, township, and range; or by another proper designation as necessary to locate precisely the limits of the site and to permit the survey to be retraced.
- The location, size, and depth of all monuments placed in making the survey shall be shown, and if any were reset by ties, that fact shall also be shown.
- Notice of setting final monuments shall be given.
- Monuments shall be placed and shall be of the type specified by the latest version of UC Davis's standard specifications.
- With DTSC's approval, the use of offset monuments properly tied to reference monuments may be allowed when necessary due to terrain, waterways, or other monuments other than those specified under subsections above.
- Benchmarks shall be set at locations required by the UC Davis Facilities Management engineer. The datum for the area within the city shall be based on datum established by the U.S. Coast and Geodetic Survey Sea Level Datum 1929, as amended.
- Identification of monuments and benchmarks shall be through the use of a standard plaque. Descriptions of all monuments and benchmarks shall be furnished for inclusion in the official records of UC Davis.
- All surveys shall conform to the California Coordinate System when required. Each final map shall show the California coordinate of every monument, and all California coordinates shall be used and shown on all traverse closure sheets, and other notes and ties that are required.

2.1.2 Residential Use Restriction at DSS 4 Area

Due to the potential elevated risk to a hypothetical resident in the DSS 4 area, residential land use, including gardening and any plant-growing activities, shall be prohibited in the DSS 4 area. Residential use includes, but is not limited to, single-family or multifamily residences, daycare facilities, and any type of educational facility for children under the age of 21. Educational use of the existing building (H-215) at the DSS 4 area is not subject to the land-use restriction, since there is no potential exposure to the contaminated soil within the building.

A covenant shall be recorded against the property with the Recorder Division of the Solano County Department of the Assessor/Recorder and DTSC prohibiting the current or future owners from permitting residential construction at the DSS 4 area.

2.1.3 Prohibition Against Interference with Monitoring System

Activities that may disturb the effectiveness of the groundwater monitoring well system (e.g. excavation, grading, removal, trenching, filling, earth movement, mining) shall not be permitted at the DOE areas at LEHR without prior review and written approval by DTSC and EPA unless such activities are expressly allowed under the terms of an approved Soil Management Plan or Operation, Maintenance, and Monitoring Plan that has not been superseded. The destruction or disturbance of monitoring wells shall be prohibited by land-use covenants. Each well shall be marked with a plaque or tag that contains a discrete identifier (CERCLA Groundwater Monitoring Well No. UCDX-XXX). The plaque or tag shall state that destructing or tampering with the well without approval from agencies who are signatories to the ROD is prohibited.

2.1.4 Soil Management Plan

Because residual contamination is left in place at LEHR, a Soil Management Plan is required to address the residual chemical and radionuclide soil contamination for all DOE areas listed in Table 1−1, except areas where No Action or No Further Action was identified. All soil-disturbing activities—including, but not limited to, excavation, grading, trenching, utility installation or repair—are subject to the requirements of the Soil Management Plan as Appendix A.

The plan defines requirements applicable to all soil-disturbing activities that may bring subsurface contaminants to the surface. The plan specifies requirements for managing radioactive waste and complies with the substantive requirements of DOE Order 435.1, *Radioactive Waste Management*.

The Soil Management Plan includes:

- An introduction to the plan, background on the site, and the plan's purpose;
- The plan's scope and applicability;
- Roles and responsibilities associated with the plan;
- The nature and extent of residual contamination based on existing soil data;
- Considerations in determining whether additional data should be collected and/or estimates of environmental fate and transport should be made;
- Identification of other required plans, permits, and documentation;
- Soil management procedures;
- Sampling and analysis procedures;
- Waste characterization and disposal; and
- Reporting and recordkeeping.

A covenant prohibiting the commencement of soil-disturbing activities without compliance with the Soil Management Plan shall be recorded against the property with the Recorder Division of the Solano County Department of the Assessor/Recorder and DTSC.

DOE has entered into a Memorandum of Agreement with the Regents of the University of California whereby UC Davis shall develop internal policies, procedures, and training to ensure the implementation of the Soil Management Plan in DOE areas (DOE 2009a). The Memorandum of Agreement is discussed in Section 2.2.1 and a copy is included as Appendix B.

2.2 Covenants to Restrict Use of the Property

A covenant is a legal document attached to the deed for real property that memorializes land-use restrictions for the subject property. Once signed and recorded, the covenant runs with the land pursuant to *California Health and Safety Code* Section 25355.5 and *California Civil Code* Section 147.1, and affects the title to the property by setting forth protective provisions, restrictions, and conditions (collectively called "restrictions"), upon and subject to which the property shall be improved, held, used, occupied, leased, sold, hypothecated, encumbered, or conveyed. Each restriction:

- Inures to the benefit of and passes with each portion of the property,
- Is for the benefit of and is enforceable by the DTSC[1],
- Is for the benefit of EPA as a third-party beneficiary[1], and
- Is imposed on the entire property unless expressly stated as applicable only to a specific portion thereof.

Covenants that address the requirements of Sections 2.1.2, 2.1.3, and 2.1.4 shall be drafted by DTSC with input from EPA, and signed by the University of California and DTSC, with EPA listed as a third-party beneficiary.[1] The CRWQCB and the California Department of Public Health will review the covenants prior to their execution.

After the covenants have been signed, the University of California shall record them against the property with the Recorder Division of the Solano County Department of the Assessor/Recorder and with DTSC to serve as a perpetual reminder to the University and all successive property owners that any change to the property that disturbs the subsurface soils must be undertaken with due care to prevent potential exposure to contaminants in those soils and that the DSS 4 area may not be used for residential occupancy.

2.2.1 Coordination with UC Davis

The University of California is the current property owner and shall enforce the covenants that restrict the use of areas of the former LEHR Federal Facility. The Regents of the University of California have agreed to provide such enforcement per a Memorandum of Agreement between DOE and the Regents (DOE 2009a). Although DOE has transferred the implementation of land-use restrictions to the University of California by agreement, CERCLA dictates that DOE

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[1] The enforcement structure is based on an interagency agreement between DTSC and EPA.

retain ultimate responsibility for remedy integrity, including maintaining, reporting on, and enforcing the land-use restrictions.

In the Memorandum of Agreement, UC Davis has agreed to:

- Record a land-use covenant that will restrict the future use of the University-owned property above the DOE areas, as described in the ROD (DOE 2009b), so that DOE (and any person designated by DOE) will have access to the former DOE areas in order that DOE may perform any long-term surveillance and maintenance (LTS&M) or contingent remediation.
- Develop and maintain internal policies and procedures to ensure that land-use restrictions are maintained. (e.g., procedures for project-specific training that shall be provided for soil-disturbing activities required according to the Soil Management Plan, Section A4.1.4)
- Visit sites to ensure that land-use restrictions are maintained.
- Develop and provide annual training for campus stakeholders affected by land-use restrictions.

DOE has provided and shall continue to provide UC Davis grant funding for conducting these and other activities. The grant shall be renewed annually for as long as DTSC requires the land-use covenants. The grant funding mechanism has been established.

2.3 Agency Notification

DOE shall notify the regulatory agencies who are signatories to the ROD of:

- Any proposals for land-use change(s) that are inconsistent with the land-use controls and assumptions described in the ROD (DOE 2009b) and this plan,
- Any anticipated action that may disrupt the effectiveness of the land-use controls,
- Any action that might alter or negate the need for the land-use controls, and
- Any anticipated transfer of the property subject to the land-use controls.

Notification requirements include:

- Notifying the regulatory agencies 45 days before any proposed land-use change;
- Notifying the regulatory agencies six months before any transfer or sale of the property; and
- Notifying the regulatory agencies as soon as practicable, but no later than 10 days, after the discovery of any activity that is inconsistent with the objectives of the land-use restrictions, or any other action that may interfere with the implementation of the land-use restrictions. The notification shall include the description of action taken to remedy any activity inconsistent with the objectives of the land-use restrictions.

Any modification of land-use controls must be approved by the regulatory agencies.

DOE shall notify the signatories to the ROD at least 90 days before the commencement of any non-emergency demolition or construction activities that could expose contaminated soil. The notification shall include:

- A description of the proposed work, with a figure identifying the affected area;
- An evaluation of the proposed work's potential impacts on human health and the environment;
- An assessment of whether the proposed work changes the appropriateness of the remedies selected in the ROD (DOE 2009b); and
- A discussion of controls that will be used to prevent impacts associated with the proposed work.

If the work is conducted in an emergency (e.g., ruptured subsurface gas line), notification beforehand is not required. However, notification shall be provided to the regulatory agencies that are signatories to the ROD as soon as practicable thereafter. The notification shall include the description of action taken, the outcome, impacts associated with the emergency and/or the work conducted, and mitigation and/or control measures employed to protect human health and the environment. For excavation or other soil-disturbing activities, additional information described in Section A5.0 of the Soil Management Plan (Appendix A) shall be provided to the agencies. After soil-disturbing activities are complete, the agencies will be notified and given the opportunity to inspect the work site.

2.4 Annual Inspections and 5-Year Reviews

Annually, DOE shall visually inspect the DOE areas of the LEHR Site to ensure compliance with land-use covenants, and shall review whether the land-use restrictions are or are not effective in preventing exposures to subsurface contaminants. The review will include:

- A verification of permits obtained for any soil-disturbing activities;
- A review of soil-disturbing activities for compliance with the Soil Management Plan;
- A review of disposal practices for waste generated during soil-disturbing activities; and
- Suggested changes to the Soil Management Plan.

DOE shall also ensure that project-specific inspections are conducted when the implementation of the Soil Management Plan is triggered. These inspections will be conducted on a schedule developed for the specific activity by an environmental professional as described in the Soil Management Plan.

DOE shall also conduct 5-year reviews to ensure that the selected remedy remains protective.

2.5 Reporting

DOE shall submit a written land-use covenant report to all ROD signatories annually. The reports shall be submitted within 30 days of the anniversary date of the ROD signature date. The reports shall include:

- Annual inspection results;
- Results of inspections conducted to comply with the requirements of the Soil Management Plan;
- A certification attesting to the compliance of the terms and conditions of the land-use covenants; and
- A discussion of any soil-disturbing activities and the final disposal of any wastes generated, any violations of the land-use covenant, and any action taken to ensure compliance with the land-use covenant.

2.6 Termination of Land-Use Restrictions

Land-use controls shall be maintained until the concentrations of contaminants in the soil are at levels that allow unrestricted use (see remediation goals in Tables 1–3 and 1–4). As long as contamination requiring the implementation of a Soil Management Plan or land-use restrictions remains in place, DOE shall continue to conduct 5-year reviews to ensure that the selected remedy remains protective. The Soil Management Plan shall be maintained and updated during 5-year reviews.

DOE may apply to DTSC for a termination of the land-use restrictions or other terms of land-use covenants for all or any portion of the LEHR Federal Facility. Such application shall be made in accordance with *California Health and Safety Code* Section 25234, and a copy of the application shall be submitted to EPA. No termination may be granted without prior notice to and opportunity to comment by EPA, CRWQCB, and the California Department of Public Health, or the successors to these agencies.

In accordance with the Memorandum of Agreement between DOE and the Regents of the University of California, following each 5-year review, DOE shall consult with EPA, DTSC, CRWQCB, and the California Department of Public Health, or the successors to these agencies, to determine whether it is necessary for the land-use covenants to remain in effect or whether the land-use covenants can be terminated entirely or amended to delete specific DOE units from the land-use restrictions (DOE 2009a).

3.0 Implementation of Long-Term Groundwater Monitoring

Residual concentrations of contaminants remain in soil at LEHR (see Section 1.6). Some of these contaminants may migrate from soil into groundwater. Long-term groundwater monitoring has been selected to ensure that if contaminants begin to impact groundwater, remedial action will be taken to prevent the degradation of water quality.

This section discusses the location of monitoring wells, compliance monitoring requirements (e.g., frequency, analytical methods), and procedures for evaluating remedial options if groundwater is impacted. Requirements for preventing the destruction or disturbance of monitoring wells shall be established as land-use covenants implemented as discussed in Section 2.1.3.

3.1 Groundwater Monitoring Locations

Groundwater samples will be collected from six existing wells (UCD1-013, -018, -021, -023, -054, and -063) and six new wells (UCD1-068 through -073) that will be installed to provide sufficient data to represent the groundwater quality beneath the DOE areas and background water quality. Figure 3–1 shows well locations, the predominant hydrostratigraphic unit (HSU)-1 groundwater flow direction in the area to be monitored, and the variability in this flow direction. Groundwater flow is predominantly to the northeast, although it seasonally may vary to be more northerly or easterly. The HSU-1 groundwater seepage velocity has been estimated between 3 and 30 ft per year (UC Davis 2004b). Any DOE areas COCs that reach HSU-1 groundwater may migrate downgradient more slowly than this due to retardation (see Appendix C for estimates of COC travel times). The 12 monitoring well locations were selected to be close enough to the areas monitored to detect releases of high mobility COCs within a few years' time (allowing for some retardation), while being sufficiently far to monitor potential impacts from an entire DOE area or a specific portion of the larger areas. Potential accessibility issues were also considered in selecting new well locations. The wells designated for monitoring each DOE area and background and the rationale for their locations are as follows:

- Existing well UCD1-054 and planned well UCD1-071 will be used to monitor the concentrations of total chromium, hexavalent chromium, mercury, molybdenum, silver, cesium-137 (Cs-137), and Sr-90 (see Table 1−4) downgradient of the Dry Wells A–E area. Well UCD1-054 is located immediately adjacent to the east and near the center of the Dry Wells A–E area. Planned well UCD1-071 will be approximately 60 ft northeast of the Dry Wells area and immediately adjacent to the northeast of DSS 1. This well will also be used to monitor the concentrations of aluminum (see Table 1−5) downgradient of DSS 1.
- Existing well UCD1-021 will be used to monitor the concentrations of nitrate (as N), carbon-14 (C-14), radium-226, and americium-241 (see Tables 1–4 and 1−5) downgradient of the Ra/Sr Treatment Systems area. Well UCD1-021 will also be used to monitor the concentrations of aluminum (see Table 1−5) downgradient of DSS 5. Although existing well UCD1-021 is not ideally located for monitoring DSS 5 (due east approximately 130 ft), no new well is proposed specifically for monitoring aluminum from DSS 5 because (1) access for well installation is very limited in the nearby downgradient direction (northeast); (2) the potential groundwater impact by aluminum is based on limited de-ionized (DI) water extraction test results without background results for comparison; and (3) the aluminum DI extraction test results were similar to those for DSS 1, and DSS 1 will have a new

monitoring point immediately adjacent (UCD1-071). If significant aluminum impact is detected and confirmed at well UCD1-071, enhanced monitoring of DSS 5 will be included as part of the response. Enhanced monitoring might include increased sampling frequency, hydropunch sampling closer to DSS 5, installation of a new monitoring well closer to DSS 5, or other enhancement, depending on the recent aluminum results for both UCD1-071 and UCD-021. The proposed response would be presented to EPA, DTSC, DPH, and CRWQCB for approval prior to implementation.

- Planned well UCD1-072 will be used to monitor the concentration of aluminum (see Table 1–5) downgradient of DSS 6 and will also be used for monitoring the Ra/Sr Treatment System area. This well will be located approximately 10 ft east of DSS 6 and approximately 45 ft east of the Ra/Sr Treatment System area.
- Planned well UCD1-069 will be used to monitor the concentrations of formaldehyde, molybdenum, nitrate, aluminum, and silver (see Tables 1–4 and 1−5) downgradient of DSS 3. The planned well location is approximately 15 ft northeast of DSS 3.
- Planned well UCD1-068 will be used to monitor the concentrations of selenium, aluminum, chromium, and nickel (see Tables 1–4 and 1−5) downgradient of DSS 4 and to supplement monitoring of the Ra/Sr Treatment System area. The planned well location is approximately 60 ft northeast of DSS 4 and approximately 150 ft northeast of the Ra/Sr Treatment System area.
- Existing well UCD1-023 and planned well UCD1-070 will be used to monitor the concentrations of nitrate, C-14, mercury, and zinc (see Tables 1–4 and 1−5) downgradient of the SWT area. Remaining soil in the SWT area with COC levels above the groundwater protection remediation goals is primarily located in the southeast corner of the area; some is also present in the western portion (as described in Weiss 2005 and the Soil Management Plan). Planned well UCD1-070 is located to monitor potential impacts from the southeast corner of the SWT, while well UCD1-023 will monitor potential impacts from soil in the western portion of the SWT area.
- Existing well UCD1-013 is approximately 35 ft east of the EDPs area and will be used to monitor the concentrations of alpha-chlordane, gamma-chlordane, and dieldrin (see Table 1−5) downgradient of this area.
- Existing background wells UCD1-018 and -063 and new well UCD1-073 will be used to collect background data for all inorganic and radiological COCs and the constituents listed in Table 1−5. The proposed location for well UCD1-073 is approximately 100 ft west of the northwest corner of the site. This location is proposed to provide background data at a greater distance from Putah Creek than the other two background wells.

All new wells shall be installed in accordance with procedures presented in Appendix D.

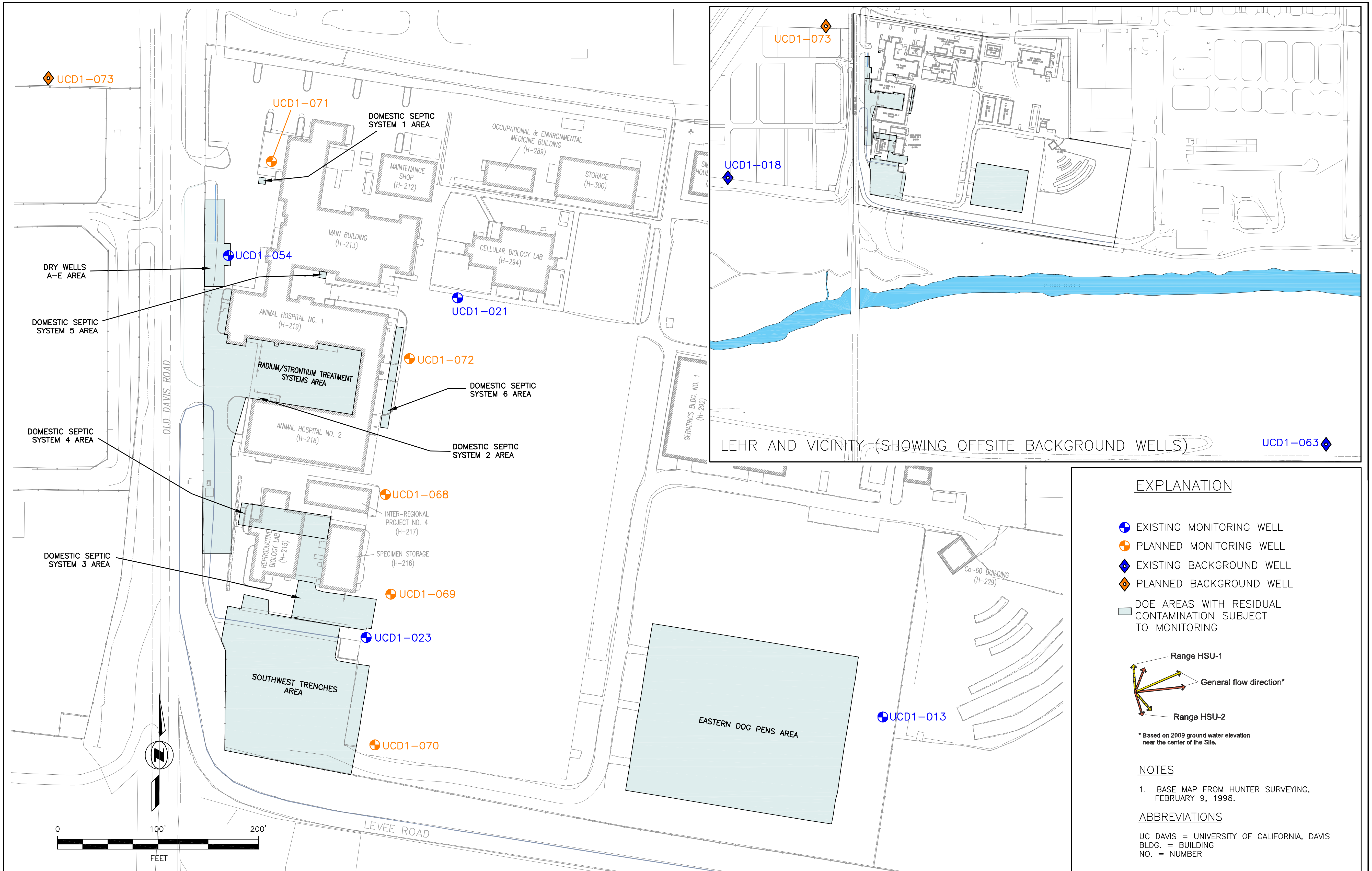

Figure 3–1. Groundwater Monitoring Locations

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3.2 Establishing the Background Groundwater Condition

Sufficient sampling will be conducted to establish background or baseline conditions against which subsequent sampling can be evaluated to determine if a contingent remedy is needed. To supplement existing background wells UCD1-018 and -063, new background well UCD1-073 will be installed west of the site (Figure 3–1). Samples will be collected from the three background wells quarterly for 1 year. One year of quarterly sampling will be sufficient to establish background because data collected over the past several years indicate no significant temporal trends in constituent concentrations for the existing background wells. Samples collected from the background wells during the first two quarters following installation of the new well will be analyzed for a full suite of potential site groundwater contaminants provided in Table 3–3 (reporting limits are provided in Appendix F).

Although the three background wells are not impacted by COCs from the site and are located upgradient of the LEHR Site, concentrations of some COCs may vary amongst the three wells due to varying influences from Putah Creek water and/or regional groundwater impacts. Provided the maximum concentration of a given COC in one well is not significantly higher than the maximum concentrations of the same COC in either of the other two wells, the maximum concentration of each constituent detected in the four quarterly samples from the three background wells will be used to represent background. If there are significant differences in concentrations detected in these background wells, the maximum concentrations for each individual background well may be used as the reference concentration for those monitoring wells that are more directly downgradient of the background well than the other background wells. Because natural variability and analytic uncertainty varies from one targeted groundwater analyte to the next, the significance of variability in maximum concentrations will be evaluated on a constituent-by-constituent basis. If all the analytical results from the background wells are below the detection limit for a given constituent, the detection limit will be used to represent a background concentration for that constituent. The evaluation of background concentrations collected over four quarters, the data collected, and the resulting background level proposed for each COC will be submitted to EPA, DTSC, CRWQCB, and the California Department of Public Health, or the successors to these agencies, for their approval.

3.3 Establishing Baseline Conditions for COCs in Groundwater

Samples will be collected from downgradient wells for four quarters to establish a baseline against which concentration trends can be evaluated. For each downgradient well, the maximum level reported for each COC will be used as the baseline value for that COC in that well.

3.4 Groundwater Sample Collection

Long-term monitoring consists of collecting groundwater samples from wells in HSU-1 that are close to the area with residual contamination, to detect contaminants in the aquifer before they can reach groundwater in HSU-2. COCs listed in Table 1−4 will be monitored at locations downgradient of DOE areas with residual contamination. COCs listed in Table 1−5 that the risk characterization (Weiss 2005) identified as possibly having a very small impact on groundwater in the future will also be monitored.

All groundwater samples will be collected according to the monitoring program shown in Table 3−1. For COCs shown in Table 1−4, samples will be collected quarterly for 1 year. Samples for COCs listed in Table 1−5 will be collected annually during the winter or spring quarter when water levels are expected to be higher. After 1 year, the sampling frequency may be adjusted based on evaluation of the monitoring data, as described in Section 3.5 below. Procedures to determine sampling frequency after the first year are given in Sections 4.1 and 4.2. Changes in sampling frequency will be proposed and documented in the annual water monitoring reports.

Samples collected at the new wells installed for this program will be analyzed for the full suite of potential site groundwater contaminants provided in Table 3–3 (laboratory-required reporting limits are specified in Table 3–3, and laboratory-specific reporting limits are provided in Appendix F) during for the first two quarters following installation. Data from these two quarterly events will be evaluated to determine if constituents other than the targeted COCs are present above the previously defined background levels provided in Table 3–3, and the levels detected in the first two quarterly samples from the one new and two existing background wells. This evaluation and any recommendations for additional sampling or other follow-up actions will be included in the Annual Water Monitoring Report and presented to EPA, DTSC, CRWQCB, and the California Department of Public Health, or the successors to these agencies, for their approval.

All monitoring activities will be conducted in accordance with the *Final Revised Field Sampling Plan* (Dames & Moore 1998) except for low-flow purging and sampling (described in Appendix E); sampling procedures provided in Appendix E; a Quality Assurance Project Plan (QAPP); and a Health and Safety Plan that addresses hazards specific to each work element, how the project will comply with environmental laws and regulations, and other issues such as area monitoring, worker training and safety, decontamination, and emergency response.

3.5 Sample Analysis and Evaluation of Groundwater Monitoring Data

Table 3–1 shows the analytical parameters and sampling frequency for all COCs subject to the long-term groundwater monitoring program. Table 3–1 also specifies the split samples required for this monitoring program, in accordance with the QAPP (DOE 2010). No trip, equipment, or field blanks are required because each well will have dedicated sampling equipment and VOCs are not part of the analytical suite. Table 3–2 specifies analytical methods, laboratory reporting limits, holding times, and maximum contaminant level remediation goals, and includes the background concentrations (provisional background) established in the *DOE Areas Remedial Investigation Report* (see Weiss 2003) for each analyte. As shown, the laboratory reporting limits are sufficiently low to allow for effective comparisons with background. The reporting limits specified for mercury, tritium, carbon-14, americium-241, and cesium-137 are the best available from among major accredited laboratories.

As shown on Table 3–2, samples for metals and radionuclides (except C-14) will be filtered prior to analysis, as specified in the QAPP approved for groundwater monitoring (DOE 2010). Due to the nature of HSU-1 soil (i.e., predominantly silt and clay), suspended solids often remain in groundwater sampled from HSU-1 wells even after thorough well development, and analyzing these samples without first filtering them can result in reported COC concentrations significantly higher than what is representative of the dissolved phase. Therefore, samples will be filtered with

Table 3–1. Groundwater Monitoring Program for DOE Areas

Wells	Well Status	Area Monitored	Radiological Analytes					Chemical Analytes												Electrical Conductivity
			Americium-241	**Carbon-14**	**Cesium-137**	**Radium-226**	**Strontium-90**	**alpha-Chlordane gamma-Chlordane Dieldrin**	**Formaldehyde**	**Hexavalent Chromium**	**Nitrates (as Nitrogen)**	**Aluminum**	**Total Chromium**	**Mercury**	**Molybdenum**	**Nickel**	**Selenium**	**Silver**	**Zinc**	
UCD1-013	Existing	EDPs	N/A	N/A	N/A	N/A	N/A	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
UCD1-018	Existing	Background	Q	Q	Q	Q	Q	N/A	N/A	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	A
UCD1-021	Existing	DSS 5 and Ra/Sr System	A	Q	N/A	Q	N/A	N/A	N/A	N/A	Q	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
UCD1-023	Existing	SWT	N/A	Q	N/A	N/A	N/A	N/A	N/A	N/A	Q	N/A	N/A	A	N/A	N/A	N/A	N/A	A	A
UCD1-054	Existing	Dry Wells	N/A	N/A	Q	N/A	Q	N/A	N/A	Q	N/A	N/A	Q	Q	Q	N/A	N/A	Q	N/A	A
UCD1-063	Existing	Background	Q	Q	Q	Q	Q	N/A	N/A	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	A
UCD1-068	Planned	DSS 4 and Ra/Sr System	A	Q	N/A	Q	N/A	N/A	N/A	N/A	Q	A	A	N/A	N/A	A	Q	N/A	N/A	A
UCD1-069	Planned	DSS 3	N/A	N/A	N/A	N/A	N/A	N/A	Q	N/A	Q	A	N/A	N/A	Q	N/A	N/A	A	N/A	A
UCD1-070	Planned	SWT	N/A	Q	N/A	N/A	N/A	N/A	N/A	N/A	Q	N/A	N/A	A	N/A	N/A	N/A	N/A	A	A
UCD1-071	Planned	Dry Wells and DSS 1	N/A	N/A	Q	N/A	Q	N/A	N/A	Q	N/A	A	Q	Q	Q	N/A	N/A	Q	N/A	A
UCD1-072	Planned	DSS 6 and Ra/Sr System	A	Q	N/A	Q	N/A	N/A	N/A	N/A	Q	A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	A
UCD1-073	Planned	Background	Q	Q	Q	Q	Q	N/A	N/A	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
Field Duplicate	Random	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	N/A
Matrix Spike	Random	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	N/A
Matrix Spike Duplicate	Random	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	N/A

Notes:

All "Planned" wells will be sampled for a full suite of analytes for the first two quarters following installation. A full suite includes metals, nitrate as N, selected radionuclides, volatile organic compounds, pesticides, and polychlorinated biphenyls, as specified in Table 3–3. See Appendix F for list of analytes and reporting limits.

QA samples (field duplicate, matrix spike, and matrix spike duplicate) will be collected at random at the frequencies indicated. Percentages listed are of total samples per the QAPP (DOE 2010). When the percentage of QC samples is a fraction, the value will be rounded up to the nearest whole number.

Abbreviations:

N/A = not applicable
Q = sampling event conducted quarterly
A = sampling event conducted annually during winter or spring quarter

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Table 3–2. Analytical Parameters for Groundwater Samples

Parameter	Method Reference	Container	Sample Handling/ Preservation	Holding Time	Detection Reporting Limit[a]	Provisional Background Level[j]	MCL[k]
Metals							
Aluminum	SW-846, Method 6020[b]	250-milliliter polyethylene plastic	Filter[i], nitric acid, pH<2	180 days	50 µg/L	N/A	1,000 µg/L
Chromium (total)					1 µg/L	40.6 µg/L	50 µg/L
Molybdenum					1 µg/L	15 µg/L	N/A
Nickel					2 µg/L	77.9 µg/L	100 µg/L
Selenium					3 µg/L	5.67 µg/L	50 µg/L
Silver					1 µg/L	5 µg/L	N/A
Zinc					10 µg/L	30 µg/L	N/A
Mercury	SW-846, Method 7470[b]	250-milliliter polyethylene plastic	Filter[i], nitric acid, pH<2	28 days	0.2 µg/L[L]	0.1 µg/L	2 µg/L
Hexavalent Chromium	SW-846, Method 7199[b]	250-milliliter polyethylene plastic	Filter [i], 4°C	24 hours	1 µg/L	39.4 µg/L	N/A
Radionuclides							
Americium-241	EML HASL 300[c]	2-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	180 days	1 pCi/L[L]	0.0155 pCi/L	N/A
Cesium-137	EPA Method 901.1[d]	1-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	180 days	5 pCi/L[L]	1.0 pCi/L	N/A
Strontium-90	EPA Method 905.0[e]	2-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	180 days	1 pCi/L	1.7 pCi/L	8 pCi/L
Carbon-14	EPA EERF C-01[f]	1-liter polyethylene plastic, glass	none	180 days	7 pCi/L[L]	3.5 pCi/L	N/A
Radium-226	EPA Method 903.1[g]	1-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	180 days	1 pCi/L	1.14 pCi/L	5 pCi/L
General							
Nitrate (as Nitrogen)	EPA Method 300.0[h]	250-milliliter polyethylene plastic	4 °C	48 hours	10 mg/L	25 mg/L	10 mg/L
Formaldehyde	SW-846, Method 8315[b]	1-liter amber glass	4 °C	72 hours	50 µg/L	0	N/A
Organics							
Alpha-Chlordane	SW-846, Method 8081[b]	1-liter amber glass (2 each)	4° C	7 days to extraction, 40 days to analysis	1.0 µg/L	0	N/A
Gamma-Chlordane					1.0 µg/L	0	N/A
Dieldrin					0.1 µg/L	0	N/A

Table 3–2. (continued) Analytical Parameters for Groundwater Samples

Notes:
[a] As shown, reporting limits are at or below MCLs for all constituents and are below the previously defined background levels for all inorganics except for mercury, americium-241, cesium-137 and carbon-14. The background values for these four constituents were based on one-half of the lowest background detection limits; therefore, the specified reporting limits were sufficiently low for comparison with background.
[b] From the *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2007).
[c] From *The Procedures Manual of the Environmental Measurements Laboratory* (DOE 1997).
[d] *Gamma Emitting Radionuclides* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[e] *Radioactive Strontium* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[f] EPA, *Eastern Environmental Radiation Facility* (EERF).
[g] *Radium-226 - Radon Emanation Technique* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[h] *Determination of Inorganic Anions by Ion Chromatography* (EPA 1993).
[i] Glass fiber, 0.45 micron filter.
[j] Provisional background levels from Appendix G of the *DOE Areas Remedial Investigation Report* (Weiss 2003); will be redefined based on baseline monitoring.
[k] Lower of California or federal primary MCL.
[L] Best available reporting limit from among major accredited laboratories.

Abbreviations:
EERF = Eastern Environmental Radiation Facility
MCL = maximum contaminant level
µg/L = micrograms per liter
mg/L = milligrams per liter
N/A = not available
pCi/L = picocuries per liter

Table 3–3. Full Suite Analytical Parameters for Groundwater Samples

Parameter	Method Reference	Container	Sample Handling/ Preservation	Holding Time	Required Laboratory Reporting Limit	Provisional Background Level[a]
Metals						
Aluminum	SW-846, Method 6020A	250-milliliter polyethylene plastic	Filter, nitric acid, pH<2	180 days	50 µg/L	N/A
Antimony					5 µg/L	5 µg/L
Arsenic					3 µg/L	8.1 µg/L
Barium					20 µg/L	187 µg/L
Beryllium					1 µg/L	1.5 µg/L
Cadmium					1 µg/L	1 µg/L
Chromium (total)					1 µg/L	40.6 µg/L
Cobalt					1 µg/L	1.8 µg/L
Copper					1 µg/L	1.7 µg/L
Iron					100 µg/L	502 µg/L
Lead					1 µg/L	1.3 µg/L
Manganese					10 µg/L	10 µg/L
Molybdenum					1 µg/L	15 µg/L
Nickel					2 µg/L	77.9 µg/L
Selenium					3 µg/L	5.7 µg/L
Silver					1 µg/L	5 µg/L
Thallium					5 µg/L	6 µg/L
Vanadium					10 µg/L	20 µg/L
Zinc					10 µg/L	30 µg/L
Mercury	SW-846, Method 7470	1 liter polyethylene plastic	Filter, nitric acid, pH<2	28 days	0.2 µg/L [b]	0.1 µg/L
Chromium+6	SW-846, Method 7199	1 liter polyethylene plastic	Filter, 4°C	24 hours	1 µg/L	39.4 µg/L
Radionuclides						
Tritium	EPA 906.0	1-liter glass	4°C	180 days	220 pCi/L [b]	110 pCi/L
Strontium-90	EPA Method 905.0	2-liter polyethylene plastic, glass	Filter, nitric acid, pH<2	180 days	1 pCi/L	1.7 pCi/L
Gross Alpha	EPA Method 900.0	1-liter polyethylene plastic, glass	Filter, nitric acid, pH<2	180 days	2 pCi/L	N/A
Gross Beta					3 pCi/L	N.A
Carbon-14	EPA EERF C-01	1-liter polyethylene plastic, glass	4°C	180 days	7 pCi/L [b]	3.5 pCi/L
Radium-226	EPA Method 903.1	1-liter glass	Filter, nitric acid, pH<2	180 days	1 pCi/L	1.1 pCi/L
Uranium-235	EPA Method 901.1	2 each 2-liter polyethylene plastic, glass	Filter, nitric acid, pH<2	180 Days	19 pCi/L	19 pCi/L
Uranium-238	EPA Method 901.1	2 each 2-liter polyethylene plastic, glass	Filter, nitric acid, pH<2	180 Days	25 pCi/L	N/A
Organics						
Volatile Organic Compounds	SW-846, Method 8260/5030	3 each 40 mL VOA	4°C, hydrochloric acid, pH<2	14 days	See Appendix F	N/A
Semi-volatile Organic Compounds	SW-846, Method 8270/3510	2 each 1-liter amber glass	4°C	7 days to extraction, 40 days to analysis	See Appendix F	N/A

Table 3−3 (continued). Full Suite Analytical Parameters for Groundwater Samples

Parameter	Method Reference	Container	Sample Handling/ Preservation	Holding Time	Required Laboratory Reporting Limit	Provisional Background Level[a]
Pesticides	SW-846, Method 8081/3510	2 each 1-liter amber glass	4°C	7 days to extraction, 40 days to analysis	See Appendix F	N/A
Polychlorinated Biphenyls	SW-846, Method 8082/3510	2 each 1-liter amber glass	4°C	7 days to extraction, 40 days to analysis	See Appendix F	N/A

Notes:
[a] Provisional background levels from Appendix G in the *DOE Areas Remedial Investigation Report* (Weiss 2003)
[b] Best available reporting limit from among major accredited laboratories.

Abbreviations:
mg/L = milligrams per liter
N/A = not available
pCi/L = picocuries per liter
µg/L = micrograms per liter

glass fiber 0.45-micron filters to remove suspended solids as well as to provide data that are consistent with the historical database for the site.

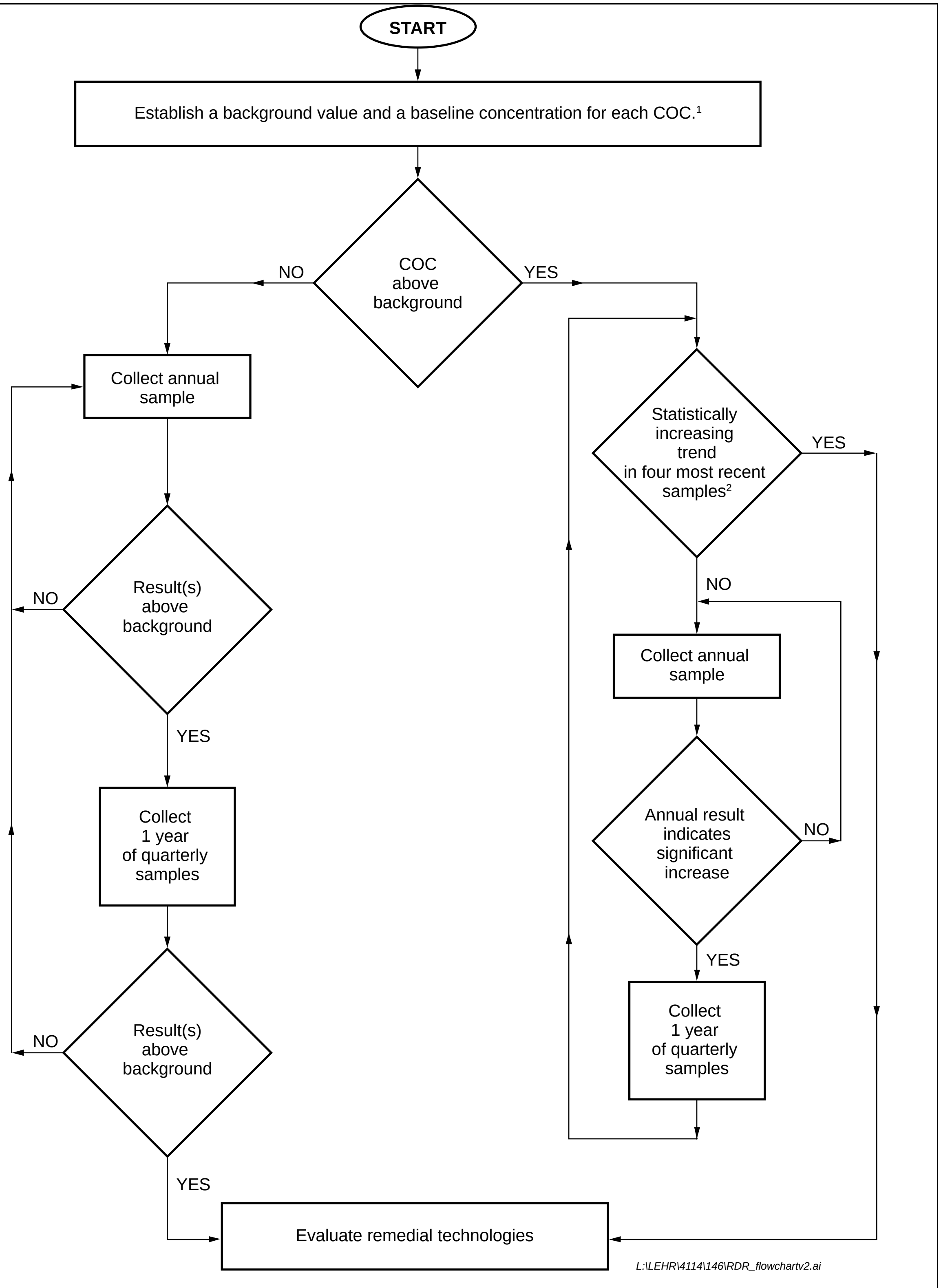
Laboratories certified through the California Environmental Laboratory Accreditation Program to perform the specified methods will analyze all samples. Laboratories selected to conduct these analyses are GEL Laboratories (GEL) in Charleston, South Carolina for radionuclides; Test America in North Canton, Ohio for formaldehyde, and CalScience Environmental Laboratories, Inc., (CEL) in Garden Grove, California for all other analyses. The completeness (that is, the percentage of valid results obtained compared to the total number of samples taken for a parameter) for each sampling event will be 90 percent (see Section 7.1, “Data Quality Objective” [DQO] Step 6). The completeness goal is per analyte per project.

As shown in Figure 3−2, after completion of the first four quarters of groundwater monitoring during which a baseline condition is established, monitoring data will be compared to the established groundwater background (see Section 3.2) and to the established baseline condition (see Section 3.3). The process for conducting these comparisons is described in Section 4.

3.6 Groundwater Monitoring for Additional Constituents

As discussed in Section 1.6, DOE has agreed to monitor groundwater concentrations of the constituents listed in Table 1−5 because these constituents were identified as possibly having a small impact on groundwater in the future at the SWT; Ra/Sr Treatment Systems; DSS 1, 3, 4, 5, and 6; Dry Wells A–E; and EDPs areas.

These constituents will be monitored in groundwater in downgradient wells annually. Background samples will be collected for these inorganic and radiological constituents quarterly for at least 1 year. Background will be established according to procedures discussed in Section 3.2. Background concentrations of organic constituents listed in Table 1−5 are presumed to be zero (below detection limits), as these constituents do not occur naturally.



Notes:

1. Background values and baseline concentrations will be established using data collected over the first four quarters of the groundwater monitoring program.
2. Increase must be above baseline to trigger contingency remediation evaluation; otherwise, proceed with annual monitoring.

Figure 3–2. Groundwater Monitoring Decision Process

The first year of monitoring data for inorganic and radiological constituents will be compared to the established background values. Inorganic and radiological constituents with concentrations below the background values and organic constituents without positive detections will continue to be monitored annually until it can be concluded that they do not threaten the groundwater.

3.7 Reporting

Results of the monitoring program will be evaluated and presented in annual water monitoring reports prepared for the site by UC Davis and in 5-year review reports. DOE will coordinate with UC Davis on the scope and content of the annual reports. These reports are expected to be similar in content and style to *Final 2009 Comprehensive Annual Water Monitoring Report* (UC Davis 2010) and will contain data evaluation including analysis of temporal COC trends, groundwater potentiometric surface maps, and isoconcentration maps of key COC. Additional data evaluation, such as Mann-Kendall or other statistical analyses, may also be included as appropriate and agreed to between UC Davis, DOE, and the regulatory agencies (EPA, DPH, CRWQCB, and DTSC)

The 5-year review reports will follow EPA's *Comprehensive Five-Year Review Guidance* (EPA 2001).

3.8 Modifications/Termination of Groundwater Monitoring

Annual adjustments to the groundwater monitoring program, including changes to requirements for split and blank sampling and analysis, will be proposed and documented in the annual water monitoring reports. If concentrations of COCs listed in Table 1−4 are below background levels or not detected for 5 consecutive years, the monitoring frequency will be reduced from annual to biannual until the next 5-year review. If concentrations of COCs listed in Table 1−4 continue to be below background levels or not detected in the following 5-year period, the sampling frequency may be further reduced to triennial or once every 5 years (approximately 1 year before the 5 year review report is due). Reduction in the monitoring frequency or termination of monitoring will be considered for specific COCs and shall be approved by the regulatory agencies prior to implementation.

Annual monitoring of COCs listed in Table 1–5 shall be conducted until it can be determined on the basis of monitoring data that these COCs no longer pose a threat to groundwater quality. Termination of monitoring of COCs listed in Table 1–5 shall be approved by regulatory agencies.

3.9 Quality Assurance Assessments

As discussed in Section 3.5, GEL, TestAmerica, and CEL will analyze samples collected as part of the groundwater monitoring program described above. Laboratory-required reporting limits are specified in Tables 3–2 and 3–3. Laboratory-specific reporting limits are provided in Appendix F. Standard operating procedures (SOPs) for the relevant analyses, and the Quality Assurance manuals for GEL, CEL, and TestAmerica laboratories are included as Appendix G.

As required by the QAPP (DOE 2010), audits of both the field and laboratory operations associated with this groundwater monitoring program will be periodically conducted. The frequency of these audits will be as follows:

- Laboratory audit—every 3 years, for laboratories providing ongoing analytical services, and prior to establishing a contract for any new laboratories.
- Field audit—once per year during the annual groundwater monitoring event conducted by UC Davis and/or its contractors (will be coordinated with the annual inspection described in Section 2.4, if practical).

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4.0 Implementation of Contingent Remediation

The long-term groundwater monitoring described in Section 3.0 may indicate that the COCs being monitored are migrating to groundwater and are impacting or may impact groundwater quality. In such a case, remedial cleanup technologies will be evaluated in accordance with CERCLA, applicable or relevant and appropriate requirements (ARARs), and the corrective action requirements of Title 27 of the *Code of California Regulations*. This section provides a decision process by which such an evaluation would be triggered.

4.1 COCs with a Baseline Concentration Greater than Background Levels

For COCs with a baseline concentration above background levels, a trend analysis will be conducted according the procedures in Chapter 6 of *Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Ground Water* (EPA 1992), or an equivalent method agreed on by EPA, CRWQCB, and DTSC. Confidence limits on the time-series linear regression slope will be tested at the alpha significance level of 1 percent. If the confidence limits are positive, the data indicate an increasing trend.

If quarterly monitoring data collected during the first year following the baseline monitoring period described in Section 3.3 suggest that there is an increasing concentration trend based on the trend analysis approach described above, background concentrations will be re-evaluated as a first step. Concentrations of COCs in samples collected from background wells since the initial establishment of background concentrations will be evaluated to assess whether background levels have increased. If no new data are available, sampling may be conducted to determine if concentrations have changed. If background levels have not increased, an evaluation of remedial cleanup technologies will be conducted.

If no increasing trend is detected based on the analysis approach described above, the sampling frequency will be changed from quarterly to annual. If the annual result does not indicate an increasing trend, the sampling frequency will remain annual, and the data will be reevaluated each year. If the annual result indicates a significant increasing trend over the baseline, the sampling frequency will return to quarterly for 1 year and will then be evaluated. If the evaluation indicates an increasing concentration trend, remedial cleanup technologies will be evaluated. The trend analysis procedures discussed above (EPA 1992), or an equivalent method agreed on by EPA and CRWQCB will be used to determine if there is an increasing trend.

Data collected during the first year will be shared with the regulatory agencies, and a path forward that may include additional data collection or a reduction in sampling frequency will be evaluated and approved by the regulatory agencies.

4.2 COCs with a Baseline Concentration Below Background Levels

COCs with baseline (first-year) concentrations below background levels will be monitored annually. If the annual monitoring result indicates that concentrations detected are above background levels, background concentrations will be re-evaluated as a first step. Concentration of COCs in samples collected from background wells since the initial establishment of background values will be evaluated to assess whether background levels have increased. If no new data are available, sampling may be conducted to determine if concentration have changed.

If background levels have not increased, the monitoring frequency for the affected downgradient well will be increased to quarterly for 1 year. If the quarterly monitoring results indicate that the concentration is consistently at or below background levels, the sampling frequency will revert to annual, and the data will be reevaluated each year.

If the quarterly monitoring data indicate that the COC concentrations have increased to levels that exceed the background levels, remedial options will be evaluated, and the appropriateness of remediation will be determined, in accordance with CERCLA and ARARs (including the evaluation and corrective action requirements of Title 27 *Code of California Regulations*).

If the COC concentrations remain below background levels for 5 years, termination of monitoring will be considered.

4.3 Groundwater Monitoring for Additional Constituents

As discussed in Sections 1.6 and 3.6, DOE has agreed to monitor groundwater concentrations of constituents listed in Table 1−5 since these constituents were identified as having a low probability of impact on groundwater in the future at the SWT; Ra/Sr Treatment Systems; DSS 1, 3, 4, 5, and 6; Dry Wells A–E; and EDPs areas.

If 1 year of quarterly monitoring confirms that inorganic or radiological constituents are present in downgradient groundwater at concentrations above background levels, or if organic constituents continue to be detected, response actions will be evaluated and implemented in accordance with CERCLA and ARARs. Since the ROD did not address these constituents, an amendment to the ROD will be necessary (DOE 2009b).

5.0 Project Organization

The DOE Office of Legacy Management is responsible for the implementation of the remedies selected in the ROD (DOE 2009b). The Site Management and LTS&M Plan (DOE 2005) defines DOE's responsibilities. The Site Management and LTS&M Plan will be updated after this Remedial Design/Remedial Action Work Plan is adopted, to ensure that the Site Management and LTS&M Plan accurately reflects the requirements of the Work Plan and those of the ROD.

A number of other organizations play a role in the remediation and long-term surveillance and maintenance of the LEHR Site. The Federal Facility Agreement and the Memorandum of Agreement for the LEHR Site define these roles, which are summarized below.

5.1 Federal Facility Agreement

The parties to the Federal Facility Agreement include DOE, EPA Region 9, DTSC, CRWQCB, and the California Department of Health Services (now California Department of Public Health). EPA has the primary regulatory authority under CERCLA, and other agencies provide active oversight with respect to State programs and regulations. All parties to the agreement have participated in project planning and prioritization and attend regular meetings. The parties provide general regulatory assistance and exchange data that they have collected. Although UC Davis is not a party to the agreement, the Federal Facility Agreement does provide for the integration of DOE and UC Davis data.

5.2 Memorandum of Agreement

The Regents of the University of California own the land on which the LEHR Federal Facility is situated, and UC Davis is responsible for most activities associated with the site. DOE has entered into a Memorandum of Agreement with the Regents, whereby DOE will provide UC Davis with a grant to perform the tasks, listed below, required by the ROD and this plan:

- Record covenants to enforce land-use restrictions;
- Conduct the tasks listed in Section 2.2.1 to ensure the implementation of land-use restrictions defined in the recorded covenants;
- Provide a process that ensures the implementation of the Soil Management Plan;
- Conduct groundwater and surface water monitoring and reporting, defined in Section 3.0, as requested by DOE; and
- Provide other services as agreed to by DOE and UC Davis.

DOE's grant to UC Davis shall be renewed annually for as long as the DTSC land-use covenants remain in place. The University of California has also agreed to give regulatory agencies access to the DOE area of the site according to the ROD requirements.

5.3 Key Personnel

Vijendra Kothari, of DOE's Office of Legacy Management, manages the implementation of the selected remedies at LEHR. As discussed in Section 5.2 above, UC Davis shall implement the groundwater monitoring, soil management, and land-use control inspections on behalf of DOE's Office of Legacy Management. In addition to UC Davis, S.M. Stoller Corporation (Stoller) supports DOE as a prime contractor in installation of the new monitoring wells, annual reporting, 5-year reviews, and general project supervision. Weiss Associates supports DOE as a subcontractor to Stoller and provides support to UC Davis under a separate contract with UC Davis.

Key positions and associated responsibilities for this project are defined in the QAPP. The persons filing these key positions at UC Davis are:

- Executive Sponsor—Jill Parker. (UC Davis)
- Program Manager—Sue Fields (UC Davis)
- Project Manager, Land Use Restrictions and Soil Management—Jim Aborn (UC Davis)
- Project Manager, Groundwater Monitoring—Bob Devany (Weiss Associates)
- Project Task Leader, Groundwater Sample Collection—Jordie Bornstein (Weiss Associates)
- Contracts Administrator—Mary Anne Brayton (UC Davis)
- Project Health and Safety Manager—Jim Aborn (UC Davis)
- Project Quality Assurance Manager—Christine Judal (UC Davis)
- Project Chemist—Brian Bandy (Weiss Associates)

Key positions and associated responsibilities for this project are defined in the QAPP. The persons filing these key positions at Stoller are:

- Executive Sponsor—Joe Legare (Stoller)
- Program Manager—Michael Butherus (Stoller)
- Project Manager, Well Installation and Implementation of Institutional Controls—Bob Devany (Weiss Associates)
- Project Task Leader, Well Installation—Tim Utterback (Weiss Associates)
- Project Task Leader, Groundwater Sample Collection—Jordie Bornstein (Weiss Associates)
- Project Task Leader, Institutional Controls Implementation—Agata Sulczynski (Weiss Associates)
- Contracts Administrator—Julie Hendricks (Stoller)
- Project Health and Safety Manager—Thomas Maveal (Stoller)
- Project Quality Assurance Manager—Michael Finton (Stoller)
- Project Chemist—Tim Utterback (Weiss Associates)
- Occurrence Coordinator—Michael Finton (Stoller)
- Project Records Administrator—Scott Raynes (Stoller)

Changes in key personnel will be documented in either the Annual Land-Use Covenant Reports (See Section 2.5) or the annual water monitoring reports (Section 3.7) depending on the changes affecting land-use covenants or groundwater monitoring.

5.4 Documents for Public Review and Comment

A formal public involvement process for decision documents is an important part of the CERCLA process and is in place to ensure that stakeholders have the opportunity to comment on cleanup and closure decisions at the site. DOE releases a draft version of all decision documents for regulatory review and comment. After regulators' comments have been addressed, the document is released for public comment and can be viewed in the Public Reading Room (see Section 5.4). A copy of the approved document and the response to comments are placed in the Administrative Record.

5.5 Administrative Record and Public Reading Room

DOE has established a Public Reading Room at the Davis Branch of the Yolo County Library in Davis (315 E 14th Street, Davis, California 95616). It contains documents and information related to the LEHR Federal Facility and copies of key documents, including the CERCLA Administrative Record and Information Repository. The Administrative Record and Information Repository are updated as new documents are created, and an index of documents in the complete collections accompanies each update. Stakeholders are notified, through public notices, when a document is available for public comment, and review copies are placed in the Public Reading Room.

5.6 Records and Data Management

All records created by DOE's Office of Legacy Management shall be managed in accordance with Title 36 *Code of Federal Regulations* Parts 1220–1236, "Agency Records Management Program" and the Federal Facility Agreement for the Site.

DOE shall maintain active records as required by the Agency Records Management Program. Active records contain information essential to the long-term care and custody of the site pursuant to applicable laws and regulations. In general, these records include site characterization reports, remedial action plans, National Environmental Policy Act documents, engineering design and construction documents, as-built drawings, results of groundwater monitoring, and annual inspection reports.

DOE's Office of Legacy Management Business Center in Morgantown, West Virginia, is currently the designated facility for archived LEHR Federal Facility records. DOE shall retain custody of the records sent to the records facility and is responsible for their destruction at the end of their approved retention periods. As stated in the Federal Facility Agreement:

- DOE shall preserve, during the pendency of this agreement and for a minimum of ten (10) years after its termination, all records and documents contained in the CERCLA Administrative Record and any additional records and documents retained in the ordinary course of business which relate to the actions carried out pursuant to this agreement.
- After this ten (10) year period, each party to this agreement shall notify the other parties at least forty-five (45) days prior to destruction of any such documents.

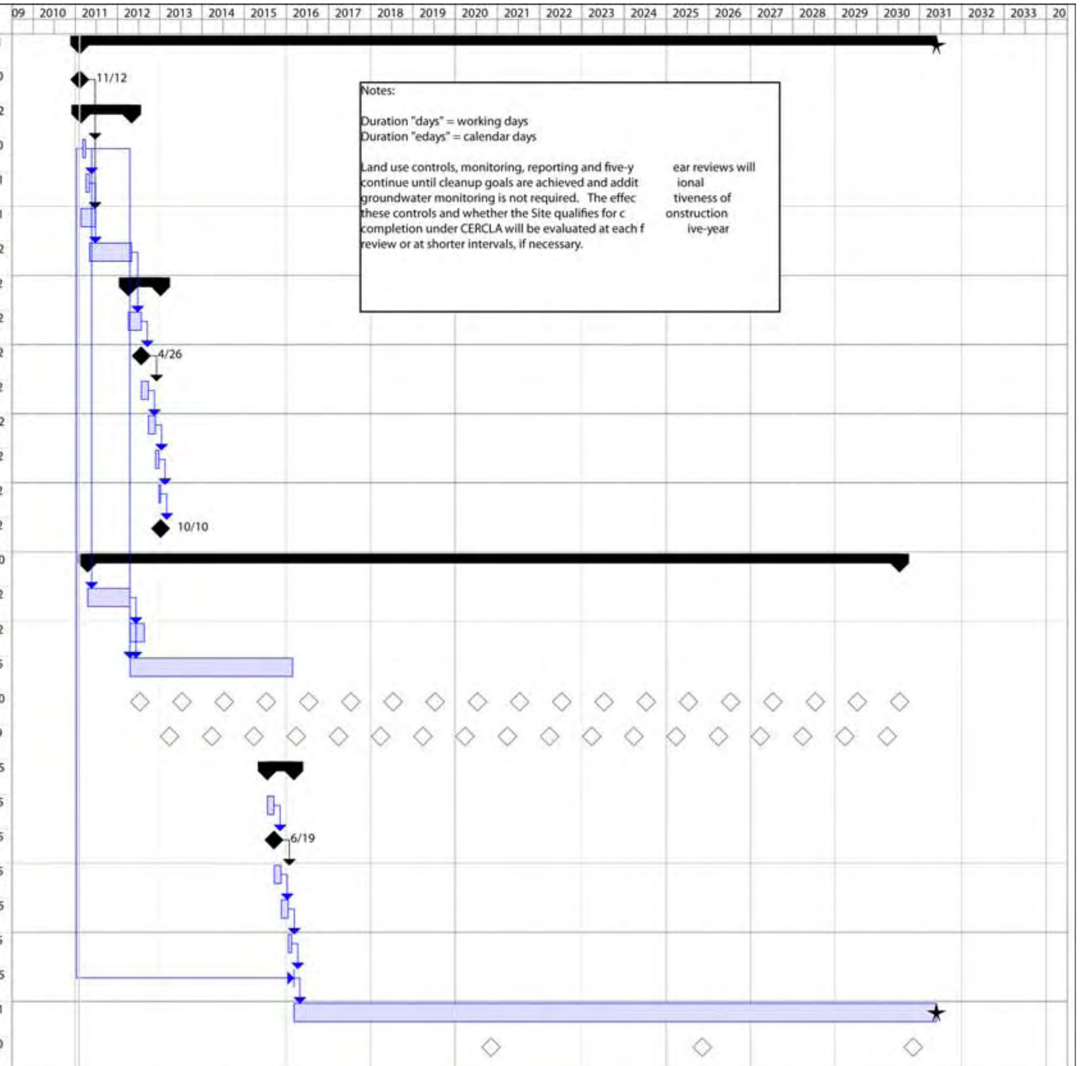
- Upon request by any party to this agreement, the requested party shall make available such records or copies of any such records unless withholding is authorized and determined appropriate by law.

All records with permanent value shall be transferred to and will be the responsibility of DOE’s Office of Legacy Management.

6.0 Schedule

Figure 6–1 provides the project schedule and lists all activities required by the ROD (DOE 2009b) and detailed in this plan. The schedule will be updated in the annual report submitted to the EPA and DTSC to reflect completed milestones and changes to the schedule.

ID	Task Name	Duration	Start	Finish
1	DOE Post-ROD Activities	5295 days	Fri 11/12/10	Thu 2/27/31
2	Finalize RD/RA Work Plan	1 day	Fri 11/12/10	Fri 11/12/10
3	Conduct Remedial Actions	314 days	Mon 11/22/10	Thu 2/2/12
4	Install Monitoring Wells	20 days	Mon 12/6/10	Fri 12/31/10
5	Conduct land survey	23 days	Mon 1/3/11	Wed 2/2/11
6	Implement Soil Management Plan	90 days	Mon 11/22/10	Fri 3/25/11
7	Establish and record deed restrictions	365 edays	Wed 2/2/11	Thu 2/2/12
8	Remedial Action Completion Report	199 days	Fri 1/6/12	Wed 10/10/12
9	Develop Draft	80 days	Fri 1/6/12	Thu 4/26/12
10	Issue Draft	0 days	Thu 4/26/12	Thu 4/26/12
11	Agency Review	43 days	Fri 4/27/12	Tue 6/26/12
12	Resolve Comments/Revise Draft	44 days	Wed 6/27/12	Mon 8/27/12
13	Agency Review of Redline Draft	22 days	Tue 8/28/12	Wed 9/26/12
14	Issue Final	10 days	Thu 9/27/12	Wed 10/10/12
15	Remedy Operational and Functional	0 days	Wed 10/10/12	Wed 10/10/12
16	Long-Term Ground Water Monitoring (Initial Phase)	5018 days	Tue 1/18/11	Mon 4/15/30
17	Collect Baseline Groundwater Samples	365 edays	Tue 1/18/11	Wed 1/18/12
18	Develop Background Data	90 days	Thu 1/19/12	Wed 5/23/12
19	Long-term Groundwater Monitoring (Initial Phase)	1007 days	Thu 1/19/12	Fri 11/27/15
20	Present Monitoring Data in AWMR (Issued by UC Davis)	4695 days	Sun 4/15/12	Mon 4/15/30
40	Annual LUC Report to DTSC and EPA	4435 days	Sat 12/29/12	Sat 12/29/29
59	First Five-year Review	164 days	Wed 4/22/15	Mon 12/7/15
60	Develop Draft	43 days	Wed 4/22/15	Fri 6/19/15
61	Issue Draft	0 days	Fri 6/19/15	Fri 6/19/15
62	Agency Review	43 days	Mon 6/22/15	Wed 8/19/15
63	Resolve Comments/Revise Draft	43 days	Thu 8/20/15	Mon 10/19/15
64	Agency Review of Redline Draft	22 days	Tue 10/20/15	Wed 11/18/15
65	Issue Final	1 day	Mon 12/7/15	Mon 12/7/15
66	Ongoing Monitoring/Reporting (As required; See note)	3973 days	Tue 12/8/15	Thu 2/27/31
67	Ongoing 5-year Reviews (As required, See note)	2609 days	Tue 8/11/20	Sun 8/11/30



Date: Wed 11/3/10

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

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Figure 6–1. Remedial Action Schedule

7.0 Quality Assurance

This section defines the DQOs for the remedial activities and provides guidance to project personnel in implementing the QAPP (DOE 2010) and associated Standard Quality Procedures (SQPs) as they apply to activities required by this Work Plan. The QAPP may be obtained from the UC Davis ES&H Unit.

7.1 Data Quality Objectives

To ensure consistency with the LEHR QAPP, EPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA 2006) was followed in developing DQOs for this Work Plan.

The EPA DQO process is used to develop performance and acceptance criteria (or DQOs) that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. Use of the DQO process leads to efficient and effective expenditure of resources; consensus on the type, quality, and quantity of data needed to meet the project goal; and the full documentation of actions taken during the development of the project.

The following are the DQOs that apply to monitoring and control of residual contamination at the site (long-term groundwater monitoring, contingency remediation, and land-use restrictions):

STEP 1. STATE THE PROBLEM. Define the problem that necessitates the study; identify the planning team; and examine budget and schedule.

Problem: The objective of this Remedial Design/Remedial Action Work Plan is to document the requirements and methods for implementing remedies selected in the ROD (DOE 2009b) for the DOE areas of LEHR. The remedies are intended to protect human health and the environment from residual contamination remaining in soil at the DOE areas of LEHR. The selected remedies (long-term groundwater monitoring; contingency remediation; and land-use restrictions) are intended to monitor and control the residual contamination at the site.

Planning Team: The planning team is comprised of DOE, UC Davis, and the regulatory agencies who are signatories to the ROD. DOE is responsible for implementing the remedies selected in the ROD, preparing this Work Plan, and ensuring its implementation. UC Davis has agreed, through a Memorandum of Agreement with DOE, to support DOE in implementing the Work Plan. UC Davis will record deed restrictions required by the ROD, conduct groundwater monitoring, oversee the implementation of the Soil Management Plan, conduct training and inspections, and provide required records to DOE. DOE retains the ultimate responsibility for compliance with the requirements of the ROD and for ensuring that the post-ROD activities presented in this Work Plan continue to be protective of human health and the environment.

Budget and Schedule: The implementation of this Work Plan is funded by DOE's Office of Legacy Management, which was established in 2003 with the primary mission of ensuring that DOE's long-term cleanup obligations are met. A LTS&M Plan identifies the post-closure actions that are defined in the ROD, remedial implementation work plans, and 5-year review findings.

The LTS&M Plan is used to communicate funding requirements to DOE management and to obtain funds from Congress for the implementation of the remedies.

Figure 6–1 provides a schedule for the implementation of post-ROD activities. This Work Plan is scheduled for approval in September 2010, and remedial action activities are scheduled to begin in August 2010. Land-use controls will run with the land in perpetuity and will bind the current property owner and all subsequent title holders. Groundwater monitoring will be conducted on a schedule included in Table 3–1. The Soil Management Plan will be in force as long as contamination remains in the soil. Updates to this plan may be made during 5-year reviews.

STEP 2. IDENTIFY THE GOAL OF THE STUDY. State how environmental data will be used in meeting objectives and solving the problem; identify study questions; and define alternative outcomes.

The data obtained from groundwater monitoring will be evaluated to determine if the remedy selected in the ROD continues to be protective of human health and the environment. The data obtained will help DOE and the regulatory agencies to:

- Define background conditions (as described in Section 3.2) at and near the site against which contaminant concentration trends can be evaluated,
- Determine if residual contaminants begin to impact groundwater,
- Undertake remedial action to prevent the degradation of water quality.

The data will be used to help answer this question: *Are residual contaminants in soil migrating to groundwater and impacting its quality as defined in the ROD?* The objective of the monitoring program is to identify threats to groundwater quality beneath the site and to determine the appropriate remedial action to be taken in case such a threat is identified.

Data collected according to the requirements of the Soil Management Plan will be used to determine the disposition of any soil that has been disturbed. The data obtained will help DOE to:

- Identify waste segregation strategies;
- Develop appropriate worker health and safety controls;
- Identify materials recycling opportunities;
- Appropriately dispose of sanitary, hazardous, low-level radioactive, and low-level mixed waste generated during soil-disturbing activities.

The data will be used to help answer this question: *What are the appropriate management and disposal options for soil generated from DOE areas subject to the Soil Management Plan?* The objective of the data collection requirements in the Soil Management Plan is to determine waste segregation, reuse, and disposal requirements.

STEP 3. IDENTIFY INFORMATION INPUTS. Identify data and information needed to answer study questions.

Data and information inputs include:

- Site background and historical information, including previous environmental investigation provided on data CD-ROM (Appendix A, Attachment C);
- Analytical results from groundwater and soil samples collected;
- Data gathered in the field (notes, photos, etc.);
- Validated laboratory analytical results; and
- Laboratory data validation.

STEP 4. DEFINE THE BOUNDARIES OF THE STUDY. Specify the target population and characteristics of interest; define spatial and temporal limits and scale of inference.

Groundwater monitoring and analysis of disturbed soil will continue until the regulatory agencies and DOE agree that such monitoring is no longer necessary for the protection of human health and the environment. Schedule modifications are subject to approval by the regulatory agencies.

The physical limits of the study area are areas of LEHR subject to land-use controls shown on Figure 2–1 and groundwater monitoring wells shown on Figure 3–1. The decision boundaries are defined in Sections 3.5 and 4.0 of this Work Plan.

STEP 5. DEVELOP THE ANALYTIC APPROACH. Define the parameter of interest, specify the type of inference, and develop the logic for drawing conclusions from findings.

Concentrations of COCs detected in groundwater will be compared to background concentrations and EPA maximum contaminant levels. Excavated soil will be evaluated according to the requirements of the Soil Management Plan in Appendix A.

If concentrations of COCs listed in Table 1−4 are below background levels for 5 consecutive years or are not detected, termination of monitoring for these COCs will be considered.

Results of the monitoring program will be evaluated as described in Sections 3.5, 3.6 and 4. Results of the evaluation will be presented in annual site water monitoring reports prepared by UC Davis and in 5-year review reports. Annual adjustments to the groundwater monitoring program will be proposed and documented in the annual water monitoring reports as described in Section 3.8.

STEP 6. SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA. Develop performance criteria for new data being collected, or acceptance criteria for existing data being considered for use.

All new data collected in conformance with this Work Plan shall be consistent with the QAPP (DOE 2010). All data used, including data from previous characterization, shall meet minimum quality requirements stated in the QAPP. Existing data are acceptable if they were collected, analyzed, and validated as described in the QAPP (DOE 2010). If modifications to the collection or analysis procedures described in this Work Plan are necessary, those changes will be evaluated for their impact on resulting data usability.

All laboratory data are from monitoring well samples. There will be a variable amount of sensitivity of project goals (identified in DQO step 2) to data completeness. An acceptance level of 90 percent should be sufficient to support most decisions. Monitoring well data can be re-collected to gain higher certainty if 90 percent is insufficient.

STEP 7. DEVELOP THE PLAN FOR OBTAINING DATA. Select the resource-effective sampling and analysis plan that meets the performance criteria.

The groundwater sampling and analysis plan is described in Section 3.0 of this Work Plan. The soil sampling and analysis plan is described in the Soil Management Plan (Appendix A).

7.2 Roles and Responsibilities

The roles and responsibilities of key personnel are described in Section 2.1 of the QAPP, and the current personnel filling key positions are presented in Section 5.3 above. Project personnel may delegate the execution of, but not the responsibility for, their quality-affecting tasks to other qualified project personnel at any time. However, key personnel may also delegate a substantial subset of their functions to a qualified deputy, who will assume full responsibility for the delegated duties. In either case, delegated duties and responsibilities shall be clearly defined, documented in writing.

7.3 Personnel Training and Qualification

Prior to the start of the any activities covered by this Work Plan, personnel training and qualification will be conducted and evaluated in accordance with Section 5 of the QAPP and SQP 3.2, “Indoctrination and Training.”

7.4 Field Documentation and Records Management

All quality-affecting records generated during activities covered by this Work Plan will be managed in accordance with Sections 4 and 8.2 of the QAPP, SQP 4.1, “Document Control,” and SQP 4.2, “Records Management.” Quality-affecting documents include, but are not limited to, personal field logs, calibration records, monitoring data, inspection checklists, sampling documentation, and procurement records.

7.5 Test Control

Analytical and geotechnical testing will be performed and documented in accordance with Section 15 of the QAPP.

7.6 Design Control

Project design calculations and drawings will be developed, reviewed, documented, and filed in accordance with Section 10 of the QAPP.

7.7 Calibration and Maintenance of Measuring and Test Equipment

Measuring and test equipment will be calibrated and maintained in accordance with Section 14 of the QAPP and SQP 8.1, "Calibration and Maintenance of Measuring and Test Equipment." Measuring and test equipment shall be calibrated and maintained according to manufacturer specifications, or as specified by project documents, procedures, or guidelines. Calibration data shall be recorded each day calibrations are performed. Data for multiple instruments may be recorded on a single form or on forms specific to the instrument. Measuring and test equipment will not be used in the field if results of calibrations are not within the tolerances specified by the manufacturer or by project documents, procedures, or guidelines.

7.8 Field Sampling

Field sampling will conform to the requirements of Section 3.0 of this Work Plan, Section 8 of the QAPP, and all applicable SOPs (Appendix I).

7.9 Procurement

All material, equipment, and subcontractor services will be procured and received according to the requirements of Section 7 of the QAPP and SQP 7.2, "Receipt Inspection."

7.10 Data Quality Assessment

As discussed in Section 7.1, long-term groundwater monitoring is intended to determine if residual contaminants in soil are impacting groundwater quality. Data quality assessment associated with soil management is addressed separately in Appendix A.

Groundwater monitoring data will be assessed as specified in the QAPP, SOPs, and SQPs and the requirements listed in this section. As a first step, the groundwater monitoring data will be evaluated to:

- Define background conditions (as described in Section 3.2) at and near the site against which contaminant concentration trends can be evaluated.
- Determine if residual soil contaminants begin to impact groundwater, by:
  - a) Establishing baseline conditions for COCs in onsite groundwater (see Section 3.3),
  - b) Determining concentration trends for COCs that are established as above background in groundwater (see Section 4.1),
  - c) Comparing concentrations to background for COCs that are established as below background (see Section 4.2), and
  - d) Determining concentration trends for constituents (non-COCs) that were identified as having a low probability of impact on groundwater (see Section 4.3).
- Undertake remedial action to prevent the degradation of water quality.

Data quality assessment will begin with validation of the sample data in accordance with the data validation procedures presented in SOP 21.1 (Appendix I). Precision and accuracy will be assessed through validation of sample duplicates, calibrations, and spike samples. The parameter that will be used to validate precision is the relative percent difference (RPD). The RPD is used to determine whether a significant difference exists among duplicate samples, including matrix spike duplicates, laboratory control sample duplicates, and/or field duplicate samples. Other approaches to assessing precision involve statistical calculations or graphical representations that may be conducted after the data are validated. Laboratory-specific acceptance limits for the RPDs of matrix spike duplicates and laboratory control sample duplicates are provided in Appendix F. Field duplicate acceptance criteria are provided in SOP 21.1 (Appendix I).

The main parameters used to assess accuracy are the matrix spike recovery and laboratory control sample spike recovery. Laboratory-specific acceptance limits for matrix spike recovery and laboratory control sample spike recovery provided in Appendix F shall be used.

Calibration is another important aspect of accuracy. Calibration will be assessed in accordance with SOP 21.1. Depending on the analysis method and analyte, linearity in the calibrated range, detector response, reference standards, and continuing calibration check standards shall be reviewed. Acceptance criteria for these parameters are discussed in SOP21.1.

Data representativeness will be achieved through the careful, informed selection, installation, and sampling of groundwater monitoring wells to represent background and onsite conditions. Samples will be collected from three background wells and eight onsite wells. Background wells will be screened in the same hydrostratigraphic unit as onsite wells to gain background data that are generally representative of onsite conditions in the absence of impacts from DOE activities. The selected locations of the existing and planned onsite wells are in proximity to each DOE area with residual soil contamination subject to monitoring. The rationale used to locate the monitoring wells is presented in Section 3.1. Representativeness also will be achieved through the proper collection and handling of samples that avoid interferences and to minimize contamination and loss (see SOPs 1.1, 2.1, and 9.1).

Comparability among measurements will be achieved through the use of the standard procedures and standard field data sheets presented in Appendix I. Also, uniform concentration units will be used for comparability.

As specified in DQO step six, the completeness goal is 90 percent. This goal is per analyte per project. If project data are rejected during data validation and the completeness goal is not met, additional samples may be collected, as necessary, to provide sufficient data. When the data are validated and complete, they will be made available to data users for comparisons, calculations, and graphical representations to support project decisions.

The groundwater background condition and baseline conditions for COCs in groundwater will be determined using individual maximum concentrations to represent population data. COCs that are determined during the baseline assessments to be below background and additional constituents identified as possibly having a low probability of impact on groundwater (Section 4.3) will be evaluated based on a comparison of a single annual sample result to the maximum year 1 background sample result. If any of these annual results are not accurate, a decision error could result. The data validation process is designed to identify and assign qualifications to data that may not be accurate. Qualified data are generally usable in statistical evaluations that include a sufficient number of samples, but project decisions may not be well supported when based upon a single qualified result. The reason for the data qualification and its impact on the decision should be taken into consideration upon use of single estimated results. To minimize decision errors, the following approaches will be taken for decisions that rely on single sample results:

1. Establishing the background groundwater condition. A maximum concentration from four quarterly samples will be used to represent groundwater background (see Section 3.2 for details regarding data from individual background wells). If the maximum concentration is qualified, its impact on the decision will be evaluated. If the qualification indicates a high bias or that the maximum concentration is not qualified but appears to be an outlier, the data can be tested according to an outlier test procedure (EPA 2006). Additional sample collection and/or selection of the next-highest concentration may be appropriate depending on the data qualification or outlier test result. Justification for the data management decision will be provided to the regulatory agencies for concurrence.

2. Establishing baseline conditions for COCs in onsite groundwater. Onsite baseline conditions will also be established using maximum concentration data. The same procedure as that stated above for establishing background condition will be used. If the maximum concentration is qualified, or determined to be an outlier, additional samples may be collected and/or the next highest concentration may be selected to represent the sample population.

3. Comparing concentrations detected in groundwater beneath the site to background concentrations (for COCs with concentrations below the established background values). The results of annual groundwater samples will be compared to the maximum background concentration. If the annual result is qualified as estimated it could lead to an incorrect decision. The reason for the qualification will be considered and the sample will be re-collected if the qualification indicates a likely decision error. Sample recollection will not be necessary for cases such as a qualified annual result that is below background, but for which the qualifier indicates that the annual result may be overestimated (high bias).

4. Comparing concentrations of additional constituents identified as having a low probability of impact on groundwater to site background values. The results of annual samples of these constituents will be compared to the maximum background concentration. If the annual result is qualified, the reason for the qualification will be considered and the sample will be re-collected if the qualification indicates a likely decision error.

Trend analysis will be used for COCs that are established as exceeding the site groundwater background values. Simple statistical quantities such as percentiles, central tendency, variance, and correlation may be calculated to supplement the trend analysis. Time series plots may also be presented. The trend analysis will be conducted according the procedures in Chapter 6 of *Methods for Evaluating the Attainment of Cleanup Standards*, Volume 2: Ground Water (EPA 1992), or an equivalent method agreed on by EPA, CRWQCB, and DTSC, such as the Mann-Kendall trend test. Based on the EPA guidance documents, the null and alternative hypotheses are:

Ho: There is no trend
Ha: There is an upward trend

The selected alpha significance level for the slope confidence limit test (EPA 1992) is 1 percent and the suggested alpha confidence level for the Mann-Kendall trend test is 5 percent (EPA 2006).

The EPA guidance documents (EPA 1992 and EPA 2006) do not indicate that Type II decision error or width of the grey region are parameters in the trend tests. The planned concentration comparisons and temporal trend analyses do not rely on distribution fit.

All of the planned data evaluations (point-to-point and trend analysis) could be significantly affected by outlier data. Statistical tests are available to determine whether a suspect result qualifies as an outlier (EPA 2006). One possible source of outlier data is a highly contaminated sample from an unrelated site inadvertently switched in the laboratory sequence with a project sample and reported as an accurate result with no data qualifications. Outlier tests provide an approach for handling this situation.

During the monitoring phase, after constituents have been established as above or below background, any significant changes or trends in concentration shall be verified by collecting a round of samples from the three background wells and the relevant onsite wells. The round of samples will be collected before taking actions such as increasing the sample frequency or conducting an evaluation of remedial technologies.

Censored data are not expected to be a significant problem for the simple comparisons and trend analyses that are planned herein, as long as contract reporting limits are met. When results are censored, the reporting limits will be compared to the requirements specified in Tables 3–2 and 3–3. Censored data that do not meet the reporting limit requirements may still be usable for project decisions if comparison criteria are above the elevated detection limits. If data with elevated reporting limits cannot be used, the reason for the reporting limit failure should be determined. Sample matrix/chemistry can cause elevated reporting limits and can be impossible to control. For cases where reporting limits can be controlled, the data set will be evaluated for completeness and the affected samples will be re-analyzed or re-collected, if necessary, to meet the 90 percent completeness goal.

When the point-to-point data comparisons and trend tests are performed, limitations will be identified and their effects on the comparison or test result explained. The tolerable limit on the trend test decision error will be verified (see alpha significance levels specified above). If a decision error exceeds the tolerable level, the error source will be identified, if possible, and corrective actions determined, if any.

Suggestions for improved data collection and statistical evaluation will be provided, as appropriate, for this ongoing groundwater monitoring project. The Project Chemist will identify the source of any failure to meet DQO performance/acceptance criteria and initiate corrective action, if necessary, to prevent future occurrences.

7.11 Inspections, Audits, and Surveillances

Inspections, audits, and surveillances will be conducted according to Sections 13 and 18 of the QAPP. Periodic inspections and audits will be conducted by trained Quality Assurance personnel. These inspections and audits will include observation of field activities and/or review of project documentation. All observations, findings, and supporting documentation resulting from the inspections and audits will be summarized in the appropriate report format and submitted to the project file.

7.12 Nonconformance Control and Corrective Action

Nonconformances and corrective actions will be addressed according to Section 16 of the QAPP and SQP 10.1, "Nonconformance Control," SQP 10.2, "Corrective Action," and SQP 10.3, "Stop Work Order."

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Appendix A

Soil Management Plan

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Soil Management Plan

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Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRWQCB	California Regional Water Quality Control Board
DOE	U.S. Department of Energy
DSS	Domestic Septic System
DTSC	California Department of Toxic Substances Control
EDPs	Eastern Dog Pens
EH&S	Environmental Health and Safety
EPA	U.S. Environmental Protection Agency
ID	identification
LEHR	Laboratory for Energy-Related Health Research
LTS&M	long-term surveillance and maintenance
MDL	method detection limit
MOA	Memorandum of Agreement
PCBs	polychlorinated biphenyls
Ra/Sr	Radium/Strontium
RD/RAWP	Remedial Design/Remedial Action Work Plan
ROD	Record of Decision
SMP	Soil Management Plan
SWT	Southwest Trenches
UC	University of California
UC Davis	University of California, Davis
WDPs	Western Dog Pens
Weiss	Weiss Associates

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1.0 Introduction

This Soil Management Plan (SMP) provides information on, and direction for managing, minor residual contamination in soil that may be disturbed during work at the U.S. Department of Energy (DOE) areas of the former Laboratory for Energy-Related Health Research (LEHR) Federal Facility. This plan is a component of the Remedial Design/Remedial Action Work Plan (RD/RAWP), which provides requirements for implementing land-use restrictions per the Record of Decision (ROD) for the DOE Areas at LEHR (DOE 2009a) issued under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. Certain activities that only disturb shallow soil (<1 foot deep) and generate *de minimis* amounts of soil (5 cubic yards or less) and that do not require off-site disposal are not subject to the requirements of this plan.

1.1 Background

From 1958 to 1988, DOE operated the LEHR Federal Facility at the south campus of the University of California, Davis (UC Davis) (Figure A–1 and Figure A–2). Research at LEHR focused on the long-term health effects of low-level radiation on laboratory animals. The disposal of chemical and radioactive laboratory and campus waste contaminated soil and groundwater at LEHR. In May 1994, the U.S. Environmental Protection Agency (EPA) added the site to the National Priorities List. The responsibilities for the cleanup of the site were divided between DOE and UC Davis: DOE is responsible for remediating soil contamination in the DOE areas shown in Figure A–2 and any associated groundwater contamination, and UC Davis is responsible for cleaning up six landfill units and any associated groundwater contamination. UC Davis is developing remedial alternatives for their areas. If land-use restrictions, including soil management requirements, are adopted for UC Davis areas, this SMP may be amended to incorporate them.

DOE has successfully completed decontamination, decommissioning, and removal actions at the DOE areas of the LEHR Federal Facility, and has thereby significantly reduced impacts of the chemical and radioactive contamination on human health and the environment to levels acceptable under CERCLA for current and anticipated land uses. Residual contaminants remain at the site at concentrations that prevent its unrestricted use (residential use) in the Domestic Septic System (DSS) 4 area, or that could contaminate groundwater above acceptable background levels.

1.1.1 Completed Removal Actions

In 1995, DOE demolished the Imhoff Wastewater Treatment Facility (Figure A–2) as a voluntary removal action, and by 1997, DOE had completed the decontamination and decommissioning of the building (62 FR 51844–51845). DOE was responsible for the remediation of the Radium/Strontium (Ra/Sr) Treatment Systems; a waste burial area known as the DOE Disposal Box; on-site domestic septic tanks, associated leach fields, and dry wells; DOE disposal trenches; and the former Dog Pens (EPA 1999). By 2009, DOE had completed removal actions that addressed the principal threats at the DOE Disposal Box area, the Southwest Trenches (SWT) area, the Ra/Sr Treatment Systems area (which included DSS 2, parts of DSS 1, and parts of the DSS 5 leach field [including Dry Wells A–E]), the Western Dog Pens (WDPs), and the DSS 3 and 6 areas (Figure A–2).

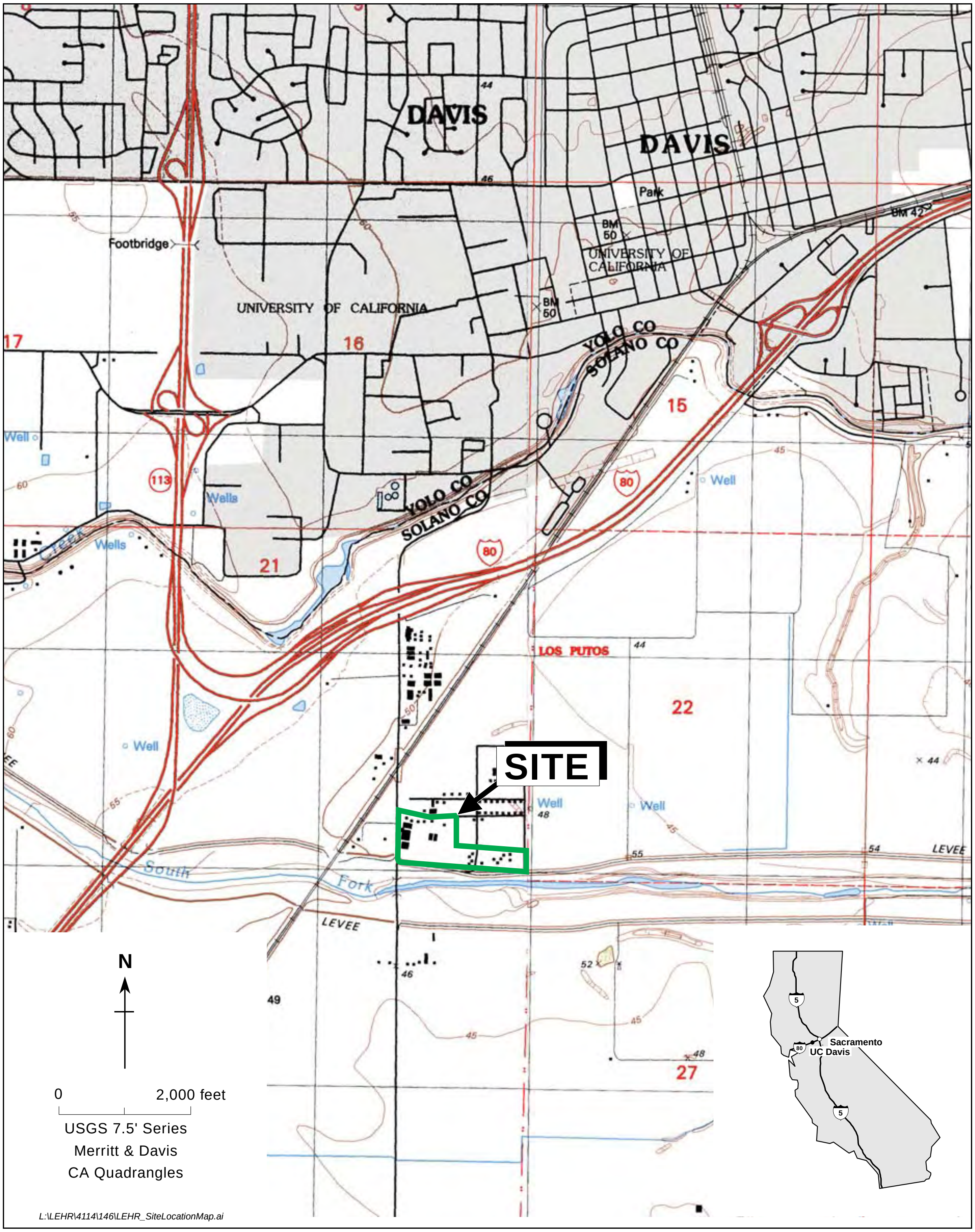

Figure A–1. Location of the LEHR Site, UC Davis, Solano County, California

Figure A–2. LEHR Site Features

1.1.2 Areas Requiring No Action or No Further Action

DOE released all of the LEHR buildings to UC Davis for unrestricted use and accelerated site cleanup by completing several removal actions that addressed the principal environmental threats at the LEHR Federal Facility. Based on DOE's compliance with DOE Order 5400.5, *Radioactive Protection of the Public and the Environment*, for the release of property for unrestricted use (62 FR 51844–51845), no action or no further action is required at all LEHR buildings (including the Imhoff Wastewater Treatment Facility demolished in 1995).

In addition to no action being necessary at the LEHR buildings, based on the *Site-Wide Risk Assessment, Volume I: Human Health Risk Assessment (Part B Risk Characterization for DOE Areas)* (Weiss 2005), no further action is required at the following areas of the LEHR Federal Facility:

- DSS areas other than DSSs 3 and 4,
- The DOE Disposal Box, and
- The WDPs area (Figure A–2).

Similarly, no action is required at the Cobalt-60 Irradiation Field because the area has no identified contamination, and there is no potential for contamination based on historical use.

Figure A–2 shows all of these areas and their designations.

1.1.3 Areas Requiring Additional Action

The following areas of the LEHR Federal Facility contain residual contaminants that present potential excess cancer risks above 1 in 1 million, or have the potential to impact groundwater quality:

- The Ra/Sr Treatment Systems area;
- DSS 3;
- DSS 4;
- Dry Wells A–E;
- The SWT area; and
- The Eastern Dog Pens (EDPs) area (Figure A–3).

1.1.4 Record of Decision

In 2009, DOE and EPA approved a ROD for the DOE areas at LEHR (DOE 2009a) in accordance with CERCLA. The ROD documents the selection of the following remedies for the DOE areas:

- Long-term groundwater monitoring with contingent remediation and an SMP at the Ra/Sr Treatment Systems area, DSS 3, Dry Wells A−E, and the SWT area.
- Long-term groundwater monitoring with contingent remediation, a land-use restriction prohibiting residential use, and an SMP at DSS 4.

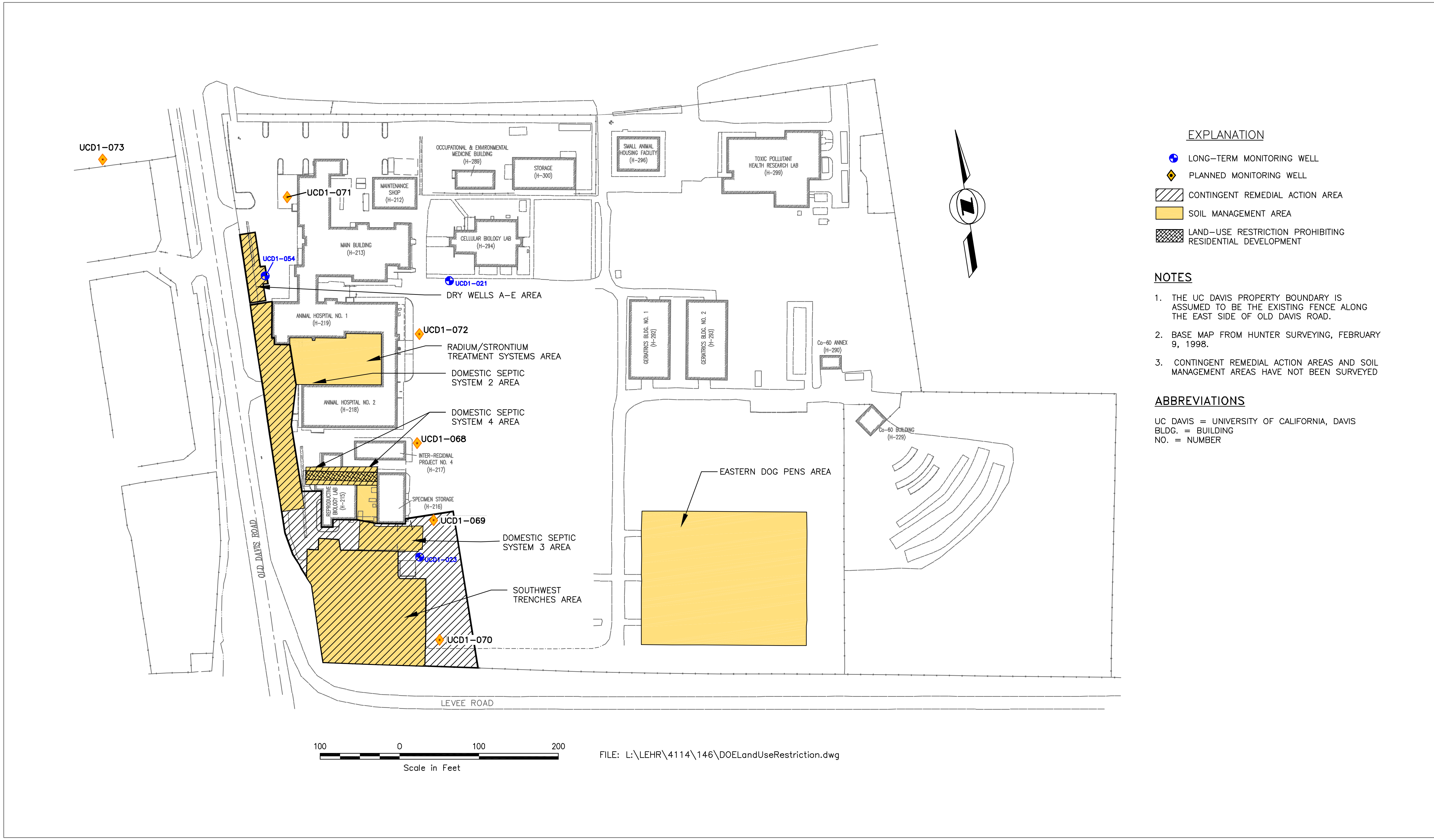

Figure A–3. DOE Areas at LEHR Subject to Land-Use Controls, Including Soil Management

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- The implementation of an SMP at the EDPs area.
- No further action at the DSS 1, DSS 5, DSS 6, DSS 7, WDPs, and DOE Disposal Box areas.

The land-use control components of the selected remedy are described in the RD/RAWP, and include the development and implementation of this SMP (which is an appendix to the RD/RAWP) to specify controls that would apply to activities that disturb the subsurface. The general requirements of the RD/RAWP and this SMP shall be documented in recorded land-use covenants.

1.2 Objective

The objective of this SMP is to establish policy and requirements for the management and disposal of soils generated during construction, maintenance, and other activities that might disturb contaminated soil at the DOE areas at LEHR.

1.3 Purpose

This SMP describes specific soil-handling controls required for compliance with the ROD (DOE 2009a). As stated in the ROD, the purpose of the SMP is to:

- Prevent unacceptable exposure to contaminated soil, and
- Prevent the improper disposal of contaminated soils.

1.4 Organization

This SMP contains:

- Background information about the DOE areas of the LEHR Federal Facility;
- The roles and responsibilities of DOE, UC Davis, and the regulatory agencies in implementing this SMP;
- Information on the nature and extent of soil contaminants at the DOE areas at LEHR;
- Requirements for the management of contaminated soils that might be disturbed during construction, maintenance, or other activities;
- Requirements for the disposal of waste soils generated during construction, maintenance, or other activities;
- Requirements for emergency work that might disturb contaminated soil;
- Inspection requirements; and
- Recordkeeping and reporting requirements.

1.5 Applicability

This SMP applies to soil-disturbing activities performed at the DOE areas at LEHR identified in Figure A–3 as subject to the SMP. Soil-disturbing activities include excavation, grading, trenching, utility installation or repair, and any other human activities that could potentially bring contaminated soil to the surface. The plan applies to such work regardless of the entity performing the work.

1.5.1 Excluded Activities

This plan does not apply to DOE areas that require no action or no further action (see Section 1.1.2 above).

The plan does not apply to landscaping, fire protection, or maintenance work that meets all of the following conditions:

- Work is conducted at depths less than 1 foot below ground surface.
- Less than 5 cubic yards of soil waste is significantly displaced (e.g., stockpiled, placed in containers).
- All soil is returned to the disturbed area.

Such work may proceed without restriction.

1.6 Duration

This SMP shall remain in effect until the concentrations of contaminants in the soil are at levels that allow unrestricted use. The regulatory agencies must approve termination of the SMP.

1.7 Revisions

This SMP shall be updated during 5-year reviews or sooner, if needed. The regulatory agencies must approve all revisions to the SMP.

2.0 Roles and Responsibilities

Implementing this SMP is the responsibility of DOE. DOE has agreed with the Regents of the University of California (UC) that the Environmental Health and Safety (EH&S) Unit at the UC Davis campus (see Section 2.2.2.1) will implement the requirements of this plan, with DOE retaining ultimate accountability for compliance with the requirements of the ROD that this SMP executes.

2.1 U.S. Department of Energy

DOE is responsible for ensuring that activities at LEHR comply with the requirements of the ROD. DOE has entered into a Memorandum of Agreement (MOA) with the UC Regents (DOE 2009b), whereby the UC Regents will perform the long-term surveillance and maintenance (LTS&M) of the remedies selected under CERCLA for the DOE areas. DOE is responsible for providing sufficient funding to ensure that the UC Regents can effectively fulfill the LTS&M requirements stipulated in the ROD.

2.1.1 DOE Office of Legacy Management

The DOE Office of Legacy Management ensures that DOE's long-term cleanup obligations are met. The Office of Legacy Management identifies actions and plans, such as this SMP, that are necessary to maintain the protection of a remedy. These actions are documented in an LTS&M Plan (DOE 2005) that states how the requirements of the ROD and remedial implementation work plans, and 5-year review findings shall be met. The LEHR LTS&M Plan defines the requirements for managing and containing soil at the site.

As part of the implementation of the LTS&M Plan, the Office of Legacy Management is responsible for annually reporting to the California Department of Toxic Substances Control (DTSC) and all other signatories to the ROD the status of land-use controls and for conducting 5-year reviews as required by the ROD.

2.2 University of California

2.2.1 UC Regents

The UC Regents have entered into an MOA (DOE 2009b), whereby the UC Regents are responsible for:

- Recording the land-use covenant with DTSC.
- Developing and maintaining internal policies and procedures to ensure that land-use restrictions (such as this SMP) are maintained.
- Visiting sites to ensure that land-use restrictions (such as this SMP) are maintained.
- Developing and providing annual training for campus stakeholders affected by the restrictions (such as this SMP).

2.2.2 UC Davis Administrative and Resource Management Division

The UC Davis Administrative and Resource Management Division provides facilities, land management, and safety services on the UC Davis campus.

2.2.2.1 EH&S Unit

The EH&S Unit within the Administrative and Resource Management Division reviews and approves projects conducted by the Design and Construction Management, Facilities Management, Campus Planning, Community Resources, and other units. The review by EH&S focuses on compliance with safety regulations. For the purpose of this SMP, the EH&S Unit is responsible for communicating the nature and scope of institutional controls applicable to the DOE areas at the LEHR Site to the other units performing or contracting work, and for ensuring that the institutional controls are implemented.

The EH&S Unit shall maintain and make available to interested parties copies of this SMP and the RD/RAWP. The EH&S Unit shall develop and maintain internal policies and procedures to ensure that:

- This SMP and other land-use restrictions are implemented;
- The DOE areas are visited to verify that all land-use restrictions are maintained; and
- Campus stakeholders affected by the restrictions receive annual training.

The EH&S Unit shall review and, upon concurrence from a qualified environmental professional (see Section 2.3), approve all requests for subsurface disturbance at the LEHR Site, and ensure that the appropriate controls are in place before and during soil-disturbing activities. The EH&S Unit shall maintain records of all activities conducted in the DOE areas and shall provide DOE with these records upon request, or as required by this SMP, the RD/RAWP, the ROD, or the MOA between DOE and the UC Regents.

2.2.2.2 Entity Performing Work

The entity that performs work in any DOE area subject to this SMP is responsible for submitting a permit application to the EH&S Unit, a successor unit or organization, or a unit to which EH&S has delegated its responsibilities under the MOA and this SMP, for review and approval before any soil-disturbing activities begin. The entity must also develop all required plans and procedures, and secure appropriate regulatory permits. The entity performing work must conduct all work in conformance with the requirements of this SMP and any requirements imposed by the EH&S Unit or regulatory agencies, and must provide the EH&S Unit with documentation required by this SMP, the Soil Disturbance Permit, and regulatory drivers.

2.3 Environmental Professional

An environmental professional will oversee all soil disturbance activities in the DOE areas subject to this SMP. The environmental professional must be qualified by education, training, or experience—or some combination—to review proposed work in areas subject to this SMP for potential risks; risk controls; waste disposal requirements; and compliance with all applicable laws, regulations, and industry standards, as applicable. For any work proposed for the DOE areas subject to this SMP, the environmental professional shall be responsible for reviewing permits, plans, and documents; advising the EH&S Unit or DOE on the appropriate methods or controls for the work; and overseeing the implementation of all controls required for the work. An environmental professional may be an employee of the University of California or a subcontractor to the University of California or DOE.

3.0 Areas and Contaminants Subject to Soil Management Requirements

This SMP applies to areas where potential contaminants remain in soil (Figure A–3).

As discussed in Section 1.1.1, DOE removed all waste from the DOE areas at LEHR. Small quantities of several contaminants remain in the soil. lists constituents that may be present in site soils from 0 to 10 feet below ground surface. All contaminants present in soil above background concentrations should be considered when soil is evaluated for on-site reuse or off-site disposal.

Site risks from the residual contamination were quantified and characterized in the site-wide risk assessments (UC Davis 2004, UC Davis 2006, Weiss 2005) that addressed human health, ecological receptors, and groundwater resources. The risk assessments showed that contaminants can remain in DOE areas' soil at concentrations above site background without posing a significant risk, depending on the contaminant's toxicity, mobility, and relative background concentration.

EPA requires that contaminants that may pose an estimated excess cancer risk greater than 1 in 1 million be evaluated further and, possibly, cleaned up. The risk assessments showed that most of the contaminants remaining in soil did not pose such a risk. Risk to the hypothetical on-site resident was below this threshold at DSS 3, Dry Wells A–E, and the Ra/Sr Treatment Systems area. The risk assessments also indicated that the potential risk to on-site construction workers was less than 1 in 1 million at DSS 3; Dry Wells A–E; and the Ra/Sr Treatment Systems, SWT, and EDPs areas.

The risk calculations were based on conservative assumptions. Risk to a hypothetical on-site resident was based on exposure to soil through direct dermal contact, ingestion, inhalation of soil particulates, ingestion of home-grown produce and external radiation from radionuclides in soil. The exposure duration for residents was assumed to extend over 30 years, including 6 years as a child and 24 years as an adult and to occur 350 days per year. Risk to a construction worker was based on exposure to soil through direct dermal contact, ingestion, inhalation of soil particulates and external radiation. The construction worker was assumed to be exposed on 250 days for the duration of 1 year.

The estimated human health risk to a hypothetical on-site resident was above 1 in 1 million for some contaminants at the DSS 4, EDPs, and SWT areas. The highest risk to the hypothetical on-site resident was 4 in 10,000 from benzo(k)fluoranthene at DSS 4, primarily due to ingesting homegrown produce. The ingestion of strontium-90 in homegrown produce also poses slight risks at the SWT area (3 in 1 million) and EDPs area (1 in 1 million). On-site construction workers were estimated to have a 1-in-1-million risk from benzo(a)pyrene in subsurface soil at DSS 4. In Table A–1, constituents of concern, due to potential human health risks, are noted with an "HH." The risk managers decided to address potential risks associated with these constituents through land-use restrictions, including this SMP. The human health risks did not necessitate the implementation of cleanup technology.

The risk assessments indicated that residual contamination in DOE areas presents no significant risks to ecological receptors; consequently, no ecological risk management actions are being taken at the DOE areas. Some contaminants at the DSS 3 and 4, Dry Wells A–E, Ra/Sr Treatment Systems, and SWT areas were found to pose potential risk to groundwater if they were to migrate from site soils to groundwater. DOE is required to monitor groundwater at the site for these constituents (noted with a "GW" in Table A–1) and evaluate the need for remedial action should these contaminants impact groundwater beneath the site. The wells that will be used for this groundwater monitoring are shown on Figure A–3.

Table A–1. Constituents Detected at DOE Areas at Concentrations Above Site Background

Area	Above-Background Constituent	Statistical Basis[a]
Domestic Septic System 3	Cesium-137	Max >UTL
	Lead-210	Max >UTL
	Strontium-90	Max >UTL
	Thallium	Max >UTL
	Zinc	Mann-Whitney (WRS Test)
	1,3-Dichlorobenzene	>5 percent detection
	1,4-Dichlorobenzene	>5 percent detection
	2-Butanone	>5 percent detection
	2-Methylnaphthalene	>5 percent detection
	Acetone	>5 percent detection
	alpha-Chlordane	>5 percent detection
	Aroclor-1254	>5 percent detection
	Benzaldehyde	>5 percent detection
	Bis(2-ethylhexyl)phthalate[b]	>5 percent detection
	Butylbenzylphthalate	>5 percent detection
	Di-n-butylphthalate	>5 percent detection
	Di-n-octylphthalate	>5 percent detection
	Dieldrin	>5 percent detection
	Diethylphthalate	>5 percent detection
	Endrin aldehyde	>5 percent detection
	Formaldehyde [GW]	>5 percent detection
	gamma-Chlordane	>5 percent detection
	Hexachlorobenzene	>5 percent detection
	Isopropylbenzene	>5 percent detection
	Methyl acetate	>5 percent detection
	Pyrene	>5 percent detection
	Styrene	>5 percent detection
	Toluene	>5 percent detection
	Trichlorofluoromethane	>5 percent detection
Domestic Septic System 4	Chromium	Mann-Whitney (WRS Test)
	Lead-210	Max >UTL
	Selenium	Max >UTL
	Strontium-90	Max >UTL
	Uranium-235	Max >UTL
	1,4-Dichlorobenzene	>5 percent detection
	2-Methylnaphthalene	>5 percent detection
	4,4'-DDE	>5 percent detection
	Acenaphthene	>5 percent detection
	Acetone[b]	>5 percent detection
	alpha-Chlordane	>5 percent detection
	Anthracene	>5 percent detection
	Benzo(a)anthracene [HH]	>5 percent detection
	Benzo(a)pyrene [HH]	>5 percent detection
	Benzo(b)fluoranthene [HH]	>5 percent detection
	Benzo(g,h,i)perylene	>5 percent detection

Table A–1 (continued). Constituents Detected at DOE Areas at Concentrations Above Site Background

Area	Above-Background Constituent	Statistical Basis[a]
Domestic Septic System 4 (continued)	Benzo(k)fluoranthene [HH]	>5 percent detection
	Bis(2-ethylhexyl)phthalate[b]	>5 percent detection
	Butylbenzylphthalate	>5 percent detection
	Carbazole	>5 percent detection
	Chlordane	>5 percent detection
	Chrysene	>5 percent detection
	Dibenzo(a,h)anthracene [HH]	>5 percent detection
	Dibenzofuran	>5 percent detection
	Ethylbenzene	>5 percent detection
	Fluoranthene	>5 percent detection
	Fluorene	>5 percent detection
	gamma-Chlordane	>5 percent detection
	Heptachlor	>5 percent detection
	Heptachlor epoxide	>5 percent detection
	Indeno(1,2,3-cd)pyrene [HH]	>5 percent detection
	Methylene chloride[b]	>5 percent detection
	Naphthalene	>5 percent detection
	Phenanthrene	>5 percent detection
	Phenol	>5 percent detection
	Pyrene	>5 percent detection
	Styrene	>5 percent detection
	Toluene	>5 percent detection
	Xylenes	>5 percent detection
Dry Wells A–E	Arsenic	Mann-Whitney (WRS Test)
	Barium	Mann-Whitney (WRS Test)
	Beryllium	Mann-Whitney (WRS Test)
	Carbon-14	Max >UTL
	Cobalt-60	Max >UTL
	Copper	Mann-Whitney (WRS Test)
	Iron	Mann-Whitney (WRS Test)
	Radium-226	Mann-Whitney (WRS Test)
	Selenium	Max >UTL
	Silver	Max >UTL
	Strontium-90 [GW]	Max >UTL
	Thorium-228	Mann-Whitney (WRS Test)
	Thorium-232	Mann-Whitney (WRS Test)
	Thorium-234	Mann-Whitney (WRS Test)
	Uranium-233/234	Mann-Whitney (WRS Test)
	Uranium-238	Mann-Whitney (WRS Test)
	Vanadium	Mann-Whitney (WRS Test)
	Zinc	Mann-Whitney (WRS Test)
	2-Butanone	>5 percent detection
	alpha-Chlordane	>5 percent detection
	Ethylbenzene	>5 percent detection
	gamma-Chlordane	>5 percent detection
	Toluene	>5 percent detection

Table A–1 (continued). Constituents Detected at DOE Areas at Concentrations Above Site Background

Area	Above-Background Constituent	Statistical Basis[a]
Eastern Dog Pens	Chromium	Mann-Whitney (WRS Test)
	Cobalt-60	Max >UTL
	Hexavalent Chromium	Mann-Whitney (WRS Test)
	Lead-210	Max >UTL
	Strontium-90 [HH]	Max >UTL
	Tritium	Max >UTL
	4,4'-DDD	>5 percent detection
	4,4'-DDE	>5 percent detection
	4,4'-DDT	>5 percent detection
	alpha-Chlordane	>5 percent detection
	Aroclor-1254	>5 percent detection
	Chlordane	>5 percent detection
	Dieldrin [HH]	>5 percent detection
	Endrin	>5 percent detection
	gamma-Chlordane	>5 percent detection
Radium/Strontium Treatment Systems	Americium-241	Max >UTL
	Barium	Mann-Whitney (WRS Test)
	Cadmium	Max >UTL
	Carbon-14 [GW]	Max >UTL
	Copper	Mann-Whitney (WRS Test)
	Hexavalent Chromium	Mann-Whitney (WRS Test)
	Iron	Mann-Whitney (WRS Test)
	Plutonium-241	Max >UTL
	Selenium	Mann-Whitney (WRS Test)
	Silver	Max >UTL
	Strontium-90	Max >UTL
	Thallium	Max >UTL
	Thorium-228	Mann-Whitney (WRS Test)
	Vanadium	Mann-Whitney (WRS Test)
	Zinc	Mann-Whitney (WRS Test)
	2-Butanone	>5 percent detection
	4,4'-DDE	>5 percent detection
	4,4'-DDT	>5 percent detection
	Acetone[b]	>5 percent detection
	alpha-Chlordane	>5 percent detection
	Bis(2-ethylhexyl)phthalate[b]	>5 percent detection
	Chlordane	>5 percent detection
	Di-n-butylphthalate	>5 percent detection
	Ethylbenzene	>5 percent detection
	gamma-Chlordane	>5 percent detection
	Methylene chloride[b]	>5 percent detection
	Toluene	>5 percent detection
	Xylenes	>5 percent detection

Table A–1 (continued). Constituents Detected at DOE Areas at Concentrations Above Site Background

Area	Above-Background Constituent	Statistical Basis[a]
Southwest Trenches	Americium-241	Max >UTL
	Antimony	Max >UTL
	Barium	Mann-Whitney (WRS Test)
	Carbon-14 [GW]	Max >UTL
	Cesium-137	Max >UTL
	Cobalt-60	Max >UTL
	Hexavalent Chromium	Mann-Whitney (WRS Test)
	Iron	Mann-Whitney (WRS Test)
	Lead-210	Max >UTL
	Plutonium-241	Max >UTL
	Selenium	Max >UTL
	Silver	Max >UTL
	Strontium-90 [HH]	Max >UTL
	Thorium-228	Mann-Whitney (WRS Test)
	Tritium	Max >UTL
	Vanadium	Mann-Whitney (WRS Test)
	Zinc	Mann-Whitney (WRS Test)
	2-Butanone	>5 percent detection
	4,4'-DDD	>5 percent detection
	4,4'-DDE	>5 percent detection
	4,4'-DDT	>5 percent detection
	alpha-Chlordane	>5 percent detection
	Dieldrin	>5 percent detection
	Ethylbenzene	>5 percent detection
	Formaldehyde	>5 percent detection
	gamma-Chlordane	>5 percent detection
	Heptachlor	>5 percent detection
	Heptachlor epoxide	>5 percent detection
	Toluene	>5 percent detection
	Xylenes	>5 percent detection

Notes:
[a] Background test results for inorganic constituents in soil from 0 to 10 feet below ground surface. The organic constituent background level is 0. Organic constituents are assumed to exceed background if the frequency of detection was 5 percent or more. Inorganic constituent statistical test results and the organic constituent frequency of detection are taken from the *Revised LEHR/SCDS Site-Wide Risk Assessment, Volume I: Human Health Risk Assessment* (UC Davis 2004).
[b] Common laboratory contaminant.

Abbreviations:
>5 percent Detection = Organic
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
DSS = Domestic Septic System
EDPs = Eastern Dog Pens
GW = Constituent of concern with potential to impact groundwater quality (DOE 2009a)
HH = Human health constituent of concern (DOE 2009a)
Mann-Whitney (WRS Test) = Constituent is above background based on results of Mann-Whitney statistical test (also known as Wilcoxon Rank Sum test).
Max >UTL = Maximum detected concentration is above the background upper tolerance limit (80 percent lower confidence limit on the 95th percentile).
Ra/Sr = Radium/Strontium
SWT = Southwest Trenches
WRS = Wilcoxon Rank Sum

4.0 Soil Management During Excavation or Construction

Soil with residual contamination may be encountered during maintenance, excavation, trenching, and other soil-disturbing activities at DOE areas at LEHR. All personnel, whether UC staff or contractors, conducting excavation, digging, or other soil-disturbing operations must be made aware that there is a potential for encountering contamination, and must know the procedures for dealing with contamination. All soil-disturbing activities at DOE areas subject to this SMP (except emergency activities) shall be conducted under the oversight of an environmental professional and shall follow the process illustrated in Figure A–4 and described below. Section 5.0 discusses emergency work.

4.1 Pre-Excavation and Pre-Construction Activities

4.1.1 Permit for Soil-Disturbing Activities

Before any soil-disturbing activities are conducted at the DOE areas, the UC Davis EH&S Unit shall be notified of the nature and location of the work to be performed. A permit application (Attachment D)—detailing the nature of the project; the project's location; and the expected depth of any proposed trenching, excavation, drilling, or other soil disturbance—shall be submitted to the EH&S Unit. No work may begin until the EH&S Unit approves the permit for the proposed project.

The EH&S staff will review the proposed work locations to determine whether the work may occur in areas subject to this SMP. In conducting this review, survey maps for the DOE areas subject to land-use restrictions shall be used. If the proposed work may be conducted in areas subject to the SMP, the EH&S Unit will ensure that the UC Davis unit or contractor performing the work is aware of all of the requirements of this SMP and will work with the unit to ensure compliance. The EH&S Unit and the environmental professional will also assist the entity performing the work in determining whether any preconstruction soil sampling is required based on the intended disposition of the soil, available contaminant data, off-site disposal facility acceptance requirements, and other factors. As outlined in the Soil Disturbance Permit (Attachment D), soil disturbed at 0–10 feet below ground surface will be sampled for constituents in Table A–1 as appropriate based on location. Soil disturbed at >10 feet below ground surface will be sampled for constituents determined by professional judgment to be potentially present in the soil in concentrations above site background, based on the data presented in Attachment C.

4.1.2 Project Evaluation and Site Inspection

An evaluation of the proposed project will be conducted by the EH&S Unit and an environmental professional, and will consist of a review of all available data, including survey maps and contaminant distribution data provided in this SMP (Section 3.0 and Attachments A and B) to determine the appropriate requirements regarding health and safety, storm water, and waste disposal. Because some of the residual contaminants are potentially subject to migration and degradation or decay, additional data and/or estimates of environmental fate and transport of residual contaminants will be considered by the EH&S Unit and environmental professional in the soil management planning process Information regarding residual contamination distribution

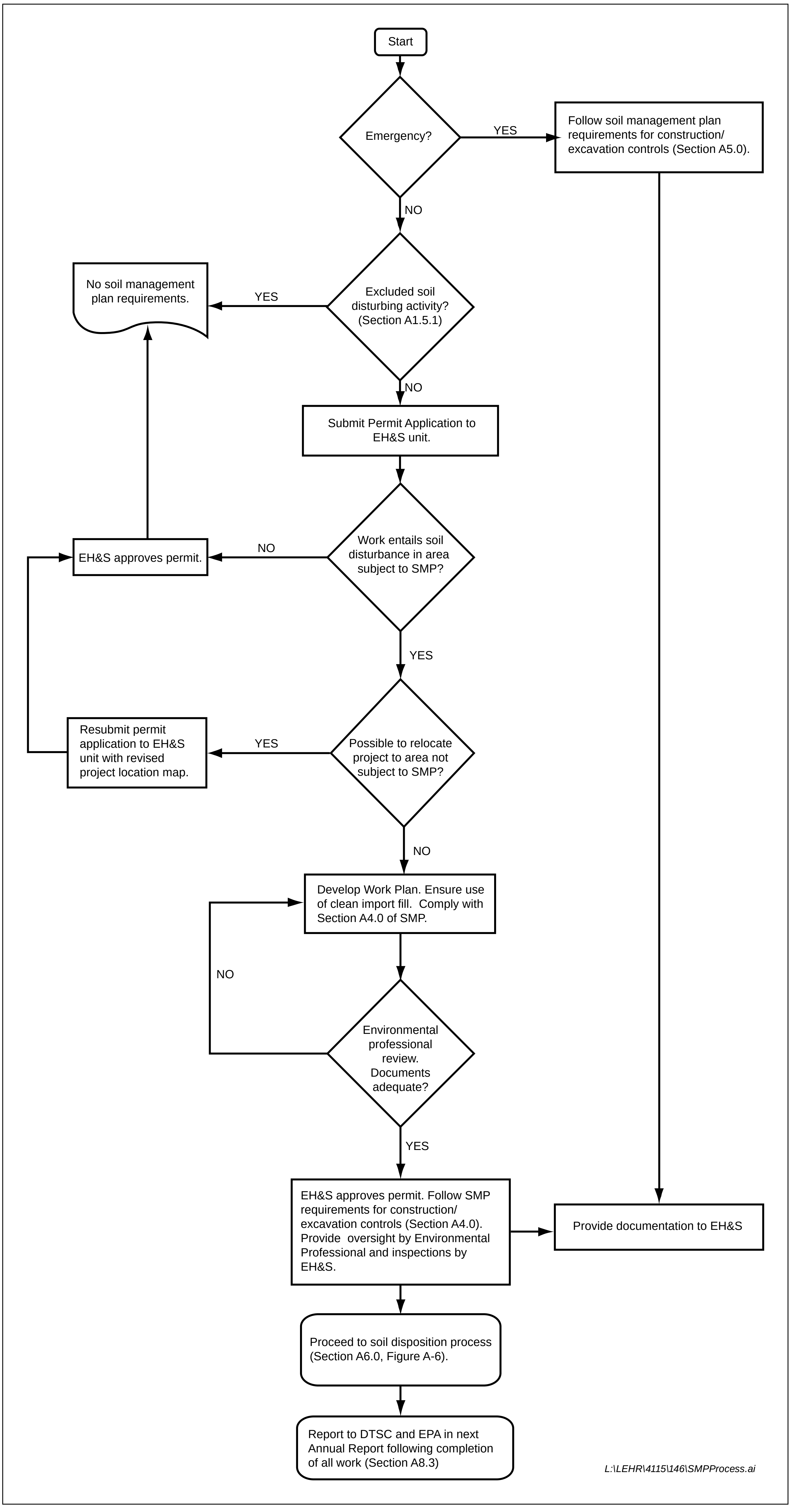

Figure A–4. Process for Conducting Non-emergency Work at the DOE Areas of the Laboratory for Energy-Related Health Research

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and fate and transport is included in the Risk Characterization Report (Weiss 2005), which may be obtained from the EH&S Unit, DOE Office of Legacy Management, or EPA.

Before any soil-disturbing activities are conducted at the DOE areas subject to this SMP, the EH&S Unit will—with the UC Davis unit or contractor performing the proposed work—inspect the site to physically identify areas of the proposed work that will be subject to the requirements of this SMP. If it is possible to move the proposed work to an area that is not subject to this SMP, or to an area with more-limited residual contamination, the EH&S Unit will recommend such a move, to avoid disturbing contaminated soils.

4.1.3 Control of Work Area

Before any soil-disturbing activities are conducted at the DOE areas subject to this SMP, the UC Davis unit or contractor performing the work shall secure the work area to limit access to only those staff that are authorized and trained to work there.

4.1.4 Training

All staff who will conduct soil-disturbing activities at the DOE areas subject to this SMP must receive appropriate training regarding the contaminants that might be present, the associated health hazards and hazard controls, soil-handling and waste-management requirements, and emergency procedures. As required by law and depending on their assignment, site workers shall be trained in hazardous waste operations and emergency response in accordance with the requirements of Title 29 *Code of Federal Regulations* Section 1910.120 and Section 5192 of Title 8 *California Code of Regulations*. Specific training requirements shall be included in work plans and Health and Safety Plans discussed below.

UC Davis implements a Safety Management Program described in the UC Davis Policy and Procedure Manual, Chapter 290, Health and Safety Services, Section 15[1]. The training related to soil-disturbing activities in the DOE areas subject to the SMP will be incorporated into this Safety Management Program.

4.1.5 Required Plans and Documentation

Before soil-disturbing activities are conducted, a work plan that covers the following topics shall be developed and approved:

- Health and safety
- Soil moving and storage procedures, including equipment to be used
- Soil sampling and analysis
- Waste management

The work plan should be tailored to the scope of the activity to be performed. Appropriate permits shall be obtained for the work to be performed.

[1] The Policy and Procedure Manual can be found at http://manuals.ucdavis.edu/PPM/290/290-15.htm

All plans for soil-disturbing activities must be reviewed by an environmental professional and approved by the EH&S Unit.

4.1.5.1 Health and Safety

The health and safety element of the work plan should address potential exposure to site contaminants and provide requirements to control such exposure, including appropriate engineering and administrative controls and personal protective equipment.

4.1.5.2 Soil Sampling and Analysis

The sampling and analysis element should be developed to ensure that samples are collected in conformance with EPA data-quality requirements, and meet the needs of the waste disposal facility in the case of off-site disposal.

4.1.5.3 Waste Management

The waste management element should include procedures for segregating, characterizing, handling, storing, treating (if anticipated), and disposing of waste. Requirements for the proper disposal of investigation-derived waste and decontamination waste shall be included. The cost of disposing of low-level radioactive waste containing chemical contaminants can be significantly higher than the cost of disposing of soil with added radiological constituents, or soil containing only chemical contamination or no contamination. Soil with added radiological constituents should be segregated from soil containing only chemical contamination or no contamination. Soil determined to be hazardous shall be transported by a licensed hauler to a permitted hazardous waste disposal facility. Soil determined to be radioactive waste or mixed radioactive waste shall be transported to a disposal facility permitted to accept radioactive or mixed waste.

4.1.6 Excavation and Construction Activities

Excavation and construction activities shall be performed in a manner that minimizes worker exposure and protects the environment from site contaminants. A designated work area boundary shall be established for excavation and construction activities.

4.1.7 Waste Segregation

Waste areas shall be secured and posted. Soil from the top 1 foot below ground surface shall be segregated and returned to backfill the top of the excavation if soils will not be sampled. Soil with added radiological constituents should be segregated from soil containing only chemical contamination or no contamination. To facilitate preliminary waste segregation decisions in DOE soil management areas, Attachments A and B provide the existing soil analytical data. The data should be used to evaluate the types of contaminants that might be present and to plan excavation, soil-handling, stockpiling, and disposal activities. The evaluation and segregation approaches should be conducted or reviewed by the environmental professional.

4.1.8 Unexpected Conditions

Excavation, digging, or other soil-disturbing activities should immediately cease upon the discovery of potentially contaminated soil or other material in an area not previously identified as containing residual contaminants or contaminated features (e.g., underground sumps, underground tanks, underground drain lines suspected of containing contamination, laboratory waste). Evidence of potentially contaminated soil or other material includes, but is not limited to:

- Discolored soil;
- Odors;
- Readings on monitoring equipment (e.g., Photoionization Detector) indicating potential presence of contaminants;
- Laboratory glassware, chemical vials, bottles or other containers;
- Drums or carboys;
- Other laboratory equipment;
- Animal wastes or bones;
- Pipes or other debris that appear to be part of an underground waste management system, such as a sump, underground tank, leach field, and so on.

The EH&S Unit must be immediately notified of the discovery.

If an excavation, digging, or other soil-disturbing activity results in an encounter with unexpected contamination identified as a CERCLA hazardous substance, notice will be promptly provided to DOE, EPA Region 9, DTSC, the California Regional Water Quality Control Board, and the California Department of Public Health so that a determination can be made regarding the need for a CERCLA response or further investigation.

4.1.9 Soil Stockpile Management

Soil stockpiles, if used, shall be placed on top of heavy-duty plastic sheeting. Wherever possible, excavated soil will be stockpiled on areas with improved asphalt or concrete surface. Potentially hazardous or radioactive waste will be stored in a designated area. Unauthorized access to such areas will be prevented by fencing or other means. Soil stockpiles shall be covered with material adequate to prevent soil transport by wind or rainwater runoff. Covers shall be maintained in good condition. When not covered, soil stockpile surfaces will be kept visibly moist by water spray, as necessary.

4.1.10 Dust Control

Dust-control measures shall be implemented in compliance with all applicable laws and regulations. During excavation, all exposed soil surfaces shall be kept visibly moist by water spray, or covered with continuous heavy-duty plastic sheeting or other covering to minimize emissions of particulates into the atmosphere. Wind speed will be monitored during excavation activities using an anemometer positioned in an open area within 200 feet of the excavation. Excavation activities shall be suspended when winds (instantaneous gusts) exceed 25 miles per hour.

Parking areas, staging areas, and traffic pathways on the site shall be cleaned as necessary to control dust emissions. Adjacent public streets shall also be cleaned if necessary when soil material from the site is visible. Soil loaded into transport vehicles for off-site disposal shall be covered with tarps or other covering to minimize emissions into the atmosphere. The covering shall be in good condition, joined at the seams, and securely anchored.

Real-time dust monitoring shall be performed at a minimum safe distance down-wind of the activity. The monitoring will be conducted to ensure that dust levels are maintained below applicable standards, such as the Yolo Solano Air Quality Management District Regulation II, Rule 2.3, Ringelmann Chart, which prohibits discharge into the atmosphere of any air pollutant, for a period or periods aggregating more than three (3) minutes in any one (1) hour which is:

a. As dark or darker in shade as that designated as No. 1 on the Ringelmann Chart, as published by the United States Bureau of Mines; or 400

b. Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in subsection 301.2 a. of this rule.

4.1.11 Surface Water Protection

Excavated soil shall be managed in a way that will not cause sediment to enter storm water runoff. Excavated soil that is suspected or known to be contaminated shall be placed in sealed containers or stockpiled and covered. The best management practices listed below shall be applied to any excavation or construction work in the DOE areas subject to this SMP. Other best management practices may be necessary depending on the nature and location of the proposed project—as determined by the EH&S Unit, the environmental professional, or both. Best management practices include:

- Designating a completely contained area away from storm drains for refueling or maintenance work that must be performed at the site.
- Cleaning up all spills and leaks using dry methods (e.g., absorbent materials, rags).
- Dry-sweeping dirt from paved surfaces, for general cleanup.
- Protecting storm drains, using earth dikes, straw bales, sandbags, absorbent socks, or other controls to divert or trap and filter runoff.
- Shoveling or vacuuming saw-cut slurry and removing it from the site.
- Not allowing rainfall or runoff to contact contaminated soil or debris.
- Scheduling excavation work for dry-weather periods, when possible.

- Avoiding over-application by water trucks for dust control.
- Protecting the area from rainfall and preventing runoff by using heavy-duty plastic and temporary roofs and berms.

4.1.12 Construction and Excavation Equipment Decontamination

Decontamination procedures protect workers from contaminants that may have accumulated on tools and other equipment. Proper decontamination also prevents the transport of potentially harmful materials to uncontaminated areas.

Construction and excavation equipment, such as drilling and excavating vehicles, shall be decontaminated at a designated location (i.e., a decontamination zone). The chosen location should be readily accessible and should be downwind and downgradient of work areas. Gross decontamination should be performed using a brush to loosen dirt and then a pressure washer or other suitable means. Cleaning and decontamination water shall be captured and placed in containers to prevent runoff from leaving the immediate work site.

All wastewater generated from decontamination activities shall be sampled and disposed of in accordance with local, State, or federal requirements. Wastewater shall be discharged to the sanitary sewer in accordance with the requirements of the UC Davis Wastewater Treatment Plant. Discharges of pollutants into the storm drain system, waters of the State, or the environment are prohibited, unless a permit is in place to allow such discharges.

4.1.13 Worker Safety

Safety measures shall be implemented in accordance with the health and safety element of the work plan or a site Health and Safety Plan.

Open excavations will be demarcated with barricades and caution tape during periods of inactivity and at the end of each workday to reduce the potential of personnel falling into the excavations. The excavations will be maintained to mitigate physical hazards to personnel working in or entering the area after work is completed.

4.2 Imported Soil Backfill

Soil for backfill may be imported from either on-site or off-site sources if soil shortages occur. Imported backfill must be sampled to ensure that contamination is not inadvertently brought onto the site. The project requestor must submit a Sampling and Analysis Plan to the EH&S Unit for approval prior to importing any material. The sampling protocol will require one 5-point composite sample for every 500 cubic yards of imported soil. For volatile organic compounds only, an individual sample will be collected according to EPA Method 5035 from each composite point, and each will be analyzed separately. At a minimum, all samples will be analyzed for the following parameters[2]:

- Soil Moisture by ASTM D2216 or equivalent,
- Metals (CAM 17) by EPA SW846 Method 6020,

[2] The current version of the method posted in EPA's updated SW846 at the time of sampling will be used. All analytic results for imported backfill should be reported based on dry weight with percent moisture reported so the results can be converted to wet weight basis when required.

- Mercury by SW846 Method 7470
- Volatile organic compounds by SW846 Method 8260,
- Semivolatile organic compounds by SW846 Method 8270,
- Pesticides by SW846 Method 8081,
- Polychlorinated biphenyls (PCBs) by SW846 Method 8082,
- Total petroleum hydrocarbons by SW846 Methods 8015M/8020,
- Nitrate by SW846 Method 300.1, and
- Hexavalent chromium by SW846 Method 7199.

The Sampling and Analysis Plan will name the analytical laboratory(ies) that will conduct the analyses, and will provide the Quality Assurance Plan, Standard Operating Procedures for the specified analyses, and tables showing reporting limits and method detection limits (MDLs) for all analytes. To the extent practical, all reporting limits should meet the detection levels shown on Table A–2. All MDLs must meet these detection levels.

The analytical data, including that for radiological constituents, will be reviewed by the environmental professional to determine whether the import soil is acceptable for use as backfill. The EH&S Unit shall approve the use of imported fill before soil is imported from either on-site or off-site sources.

5.0 Soil Management During Emergency Work

Emergency excavation or soil-disturbing activities that are required to protect human health, the environment (e.g., a broken gas line), or property may be performed in the DOE areas as required. Residual contaminants at the DOE areas do not pose a short-term threat to human health or the environment. The process illustrated in Figure A–5 shall be followed for emergency work.

When practicable, the entity conducting emergency activities shall notify the EH&S Unit of the work. The EH&S Unit will provide guidance and may monitor the emergency excavation or soil-disturbing activities. Excavated soils must be placed in containers or stockpiled—or both—at the work site on an impervious surface (e.g., tarps, heavy-plastic sheeting), must have proper storm water controls, and must be protected from wind erosion and inclement weather until they can be evaluated for proper disposal. If immediate backfilling is necessary as part of the emergency response, soils excavated during emergency activities may be returned to the excavation; otherwise, soil excavated during the emergency will be evaluated as excavated waste according to the procedures in Section 6.0 and Figure A–6 after the emergency response is concluded. If the excavated soil (stockpiled, containerized, or returned to the excavation)is determined unacceptable for reuse, it will be removed and properly disposed of. The excavated soil will be replaced with imported backfill that has been tested and approved as acceptable as specified in Section 4.3 above.

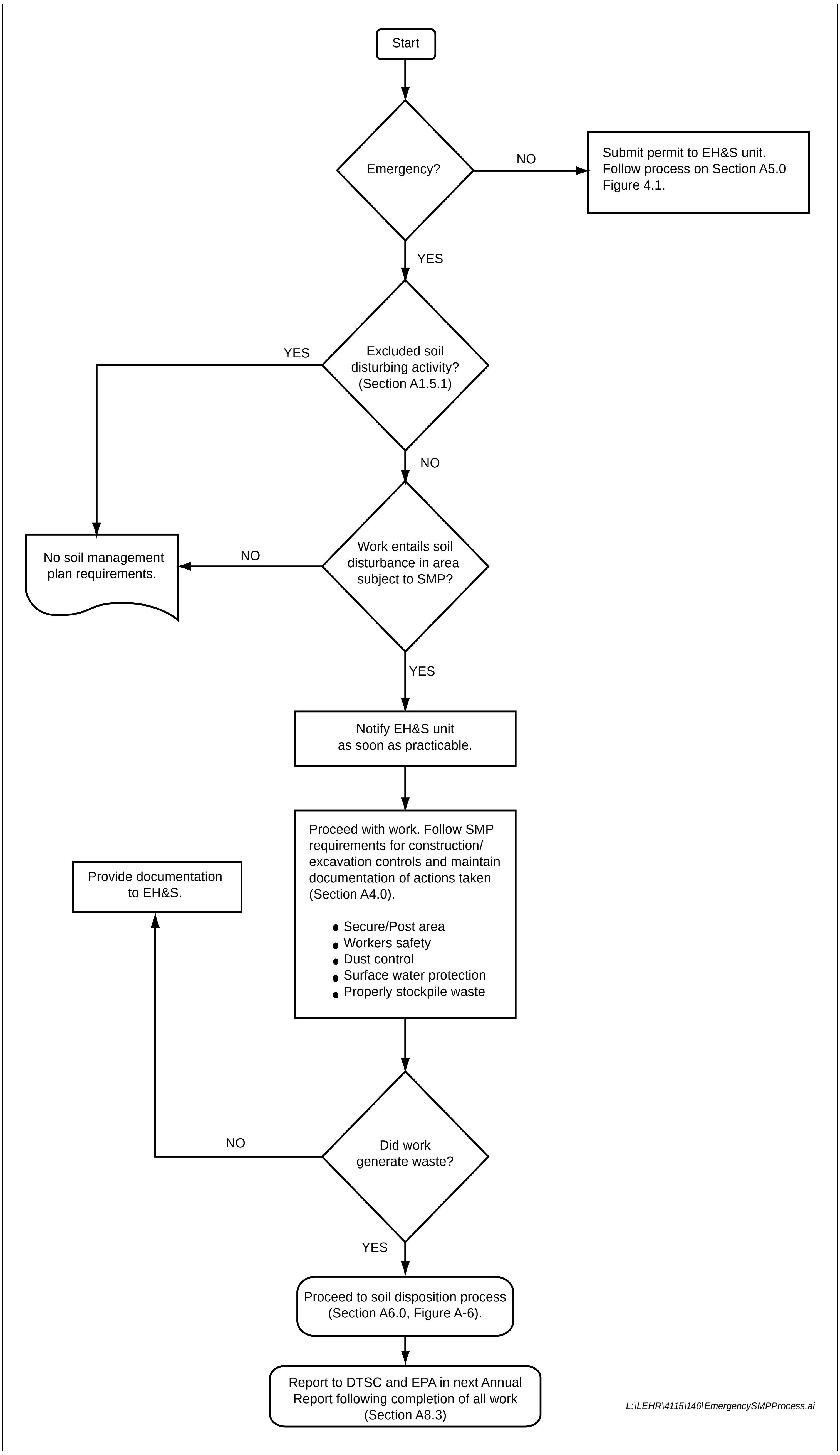

Figure A–5. Process for Conducting Emergency Work at the DOE Areas of the Laboratory for Energy-Related Health Research

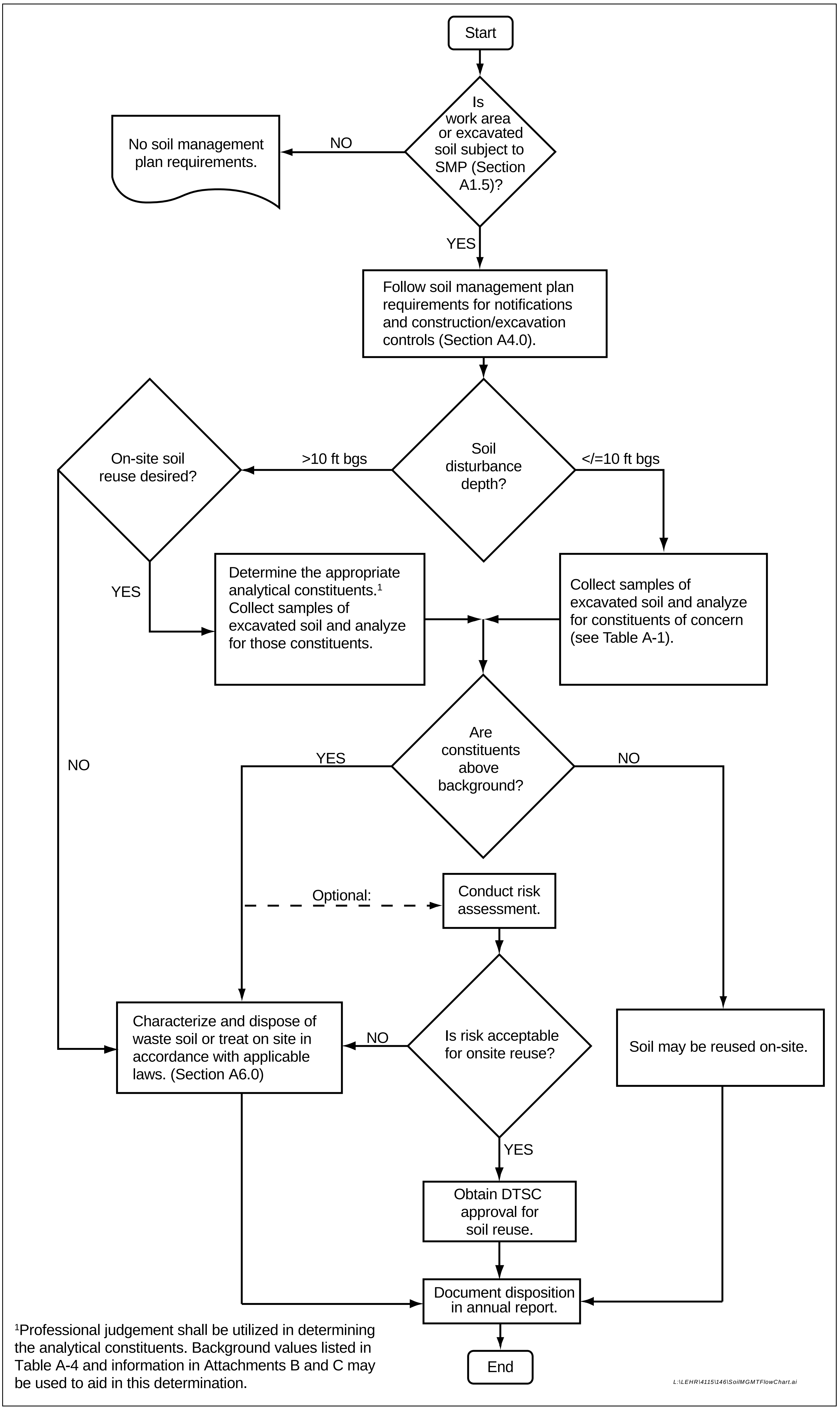

Figure A–6. Decision Process for Disposal of Excavated Soil

Table A–2. Laboratory Analysis Parameters, Analytical Methods, Containers, Holding Times, and Required Detection Limits for Soil/Solid Waste Samples

Parameter (Container)	Analytical Method[a]	Required Detection Limit (pCi/g for radiochemicals, mg/kg for metals/general chemistry)	Holding Time	DOE Area
Laboratory Analyses				
Radionuclides (16-ounce glass [2 each]):				
Americium-241	EML HASL 300[b]	0.01	6 months	Ra/Sr, SWT
Carbon-14	EPA EERF C-01[c]	0.1	6 months	Ra/Sr, Dry Wells, SWT
Gamma Emitters	—	—	—	
Cesium-137	EPA 901.1	0.005	6 months	DSS 3, Dry Wells, SWT
Cobalt-60	EPA 901.1	0.005	6 months	Dry Wells, EDPs, SWT
Lead-210	EPA 901.1	1	6 months	DSS 3, DSS 4, EDPs, SWT
Radium-226[d]	EPA 901.1	0.05	6 months	Ra/Sr, Dry Wells
Thorium-234	EPA 901.1	0.5	6 months	Dry Wells
Plutonium-241	EML HASL 300[b]	0.5	6 months	Ra/Sr, SWT
Strontium-90	EPA Method 905.0[e]	0.05	6 months	Ra/Sr, DSS3, DSS4, Dry Wells, EDPs, SWT
Tritium	EPA Method 906.0[f]	1	6 months	EDPs, SWT
Thorium-228	EML HASL 300[b]	0.1	6 months	Ra/Sr, Dry Wells, SWT
Thorium-232	EML HASL 300[b]	0.05	6 months	Dry Wells
Uranium-233/234	EML HASL 300[b]	0.025	6 months	Dry Wells
Uranium-235	EML HASL 300[b]	0.01	6 months	DSS 4
Uranium-238	EML HASL 300[b]	0.025	6 months	Dry Wells
Metals (4-ounce glass [2 each]):				
Antimony	SW-846, Method 6020A[g]	1	6 months	SWT
Arsenic	SW-846, Method 6020A[g]	1	6 months	Dry Wells
Barium	SW-846, Method 6020A[g]	40	6 months	Ra/Sr, Dry Wells, SWT
Beryllium	SW-846, Method 6020A[g]	0.1	6 months	Dry Wells
Cadmium	SW-846, Method 6020A[g]	0.1	6 months	Ra/Sr
Chromium (total)	SW-846, Method 6020A[g]	1	6 months	DSS 4, Dry Wells, EDPs
Copper	SW-846, Method 6020A[g]	1	6 months	Ra/Sr, Dry Wells
Iron	SW-846, Method 6020A[g]	20	6 months	Ra/Sr, Dry Wells, SWT

Table A–2 (continued). Laboratory Analysis Parameters, Analytical Methods, Containers, Holding Times, and Required Detection Limits for Soil/Solid Waste Samples

Parameter (Container)	Analytical Method[a]	Required Detection Limit (pCi/g for radiochemicals, mg/kg for metals/general chemistry)	Holding Time	DOE Area
Laboratory Analyses				
Mercury	SW-846, Method 7471[g]	0.1	28 days	Dry Wells
Molybdenum	SW-846, Method 6020A[g]	0.1	6 months	DSS 3, Dry Wells
Selenium	SW-846, Method 6020A[g]	1	6 months	Ra/Sr, DSS 4, Dry Wells, SWT
Silver	SW-846, Method 6020A[g]	0.25	6 months	Ra/Sr, Dry Wells, SWT
Thallium	SW-846, Method 6020A[g]	0.5	6 months	Ra/Sr, DSS 3
Vanadium	SW-846, Method 6020A[g]	1	6 months	Ra/Sr, Dry Wells, SWT
Zinc	SW-846, Method 6020A[g]	1	6 months	Ra/Sr, DSS 3, Dry Wells, SWT
General Chemistry (4-ounce glass)				
Hexavalent Chromium	SW-846, Method 3060A/7196[g]	0.1	24 hours	Ra/Sr, Dry Wells, EDPs, SWT
Nitrate	EPA Method 300.0[h]	1	48 hours	Ra/Sr, DSS 3, SWT
Organics:				
Volatile Organic Compounds (VOA vials [4 each] [12 VOA vials for MS/MSD samples])	SW-846, Method 8260/5035[g]	See Table A–3	14 days Na bisulfate methanol	Ra/Sr, DSS 3, DSS 4, Dry Wells, SWT
Semivolatile Organic Compounds (4-ounce glass)	SW-846, Method 8260[g]	See Table A–3	14 days to extraction, 40 days to analysis of extract	Ra/Sr, DSS 3, DSS 4
Pesticides/Polychlorinated Biphenyls (4-ounce glass)	SW-846, Method 8081/8082[g]	See Table A–3	14 days to extraction, 40 days to analysis of extract	Ra/Sr, DSS 3, DSS 4, Dry Wells, EDPs, SWT
Formaldehyde (125-milliliter wide-mouth amber glass)	SW-846, Method 8315[g]	0.1	7 days	DSS 3, SWT

Table A–2 (continued). Laboratory Analysis Parameters, Analytical Methods, Containers, Holding Times, and Required Detection Limits for Soil/Solid Waste Samples

Notes:
[a] Or equivalent method. The laboratory must be certified through the California Department of Public Health. If the soil will be disposed of outside of California, the laboratory must also be certified in the state of the disposal facility.
[b] From *The Procedures Manual of the Environmental Measurements Laboratory* (DHS 1997).
[c] *Tritium* from *Prescriptive Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[d] Requires 30-day in-growth time and 1,000-minute count time.
[e] *Radioactive Strontium* from *Prescriptive Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[f] EPA, *Eastern Environmental Radiation Facility* (EERF).
[g] From *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2007).
[h] *Determination of Inorganic Anions by Ion Chromatography* (EPA 1993).

Abbreviations:
EPA = U.S. Environmental Protection Agency
mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram
Ra/Sr = Radium/Strontium Treatment Systems
DSS3 = Domestic Septic System 3
DSS4 = Domestic Septic System 4
Dry Wells = Domestic Septic System Dry Wells A–E
EDPs = Eastern Dog Pens
SWT = Southwest Trenches

When emergency excavation or soil-disturbing activities occur, the extent of the emergency work shall be documented, including the date the work was performed, who performed the work, the nature of the work, the volumes of soil disturbed, the nature and extent of any contamination discovered, the final disposal of any soils, and the resolution of the emergency situation. The documentation shall be submitted to the EH&S Unit within 30 days of the event. Waste that was generated during any emergency activity and that disturbs potential contaminated soils in the DOE areas subject to this SMP must be managed in accordance with the requirements of Section 6.0.

6.0 Characterization and Disposal of Excavated Waste

This section provides requirements and a process for managing the disposal of waste soils (clean or contaminated) generated during maintenance, construction, excavation, and similar activities, and provides a process for determining how excavated soils shall be disposed of. Waste designation criteria and sampling and analysis specifications are included to ensure that a method consistent with the LEHR ROD is used in making decisions.

6.1 Soil Designation Categories

Waste soil may be categorized as follows:

- Clean—Soil that contains constituents at or below site background concentrations.
- Nonhazardous—Soil with no added radioactivity and detectable levels of hazardous substances that are above background but below applicable federal and California hazardous waste standards.
- Hazardous—Soil with levels of hazardous substances above applicable federal and California hazardous waste standards.
- Radioactive—Soil with activities of radionuclides above site background levels.

Soil must be disposed of according to its categorization.

6.2 Soil Characterization

Figure A–6 summarizes the soil-management process. All soil excavated from DOE areas subject to soil management requirements (Figure A–3) must be characterized to determine if the soil is clean, nonhazardous, hazardous, or radioactive (see Section 6.1). Samples of excavated soil must be analyzed for waste characterization purposes. Sufficient data must be collected to meet the waste acceptance criteria of a disposal facility if the soil will not be reused on site.

6.2.1 Soil Sample Collection

Before samples are collected, the project requestor must submit to the EH&S Unit a project-specific Sampling and Analysis Plan (an element of the Work Plan). The EH&S Unit will review the Sampling and Analysis Plan and determine its adequacy.

Depending on the type of work to be conducted, the Sampling and Analysis Plan shall specify whether samples will be collected during waste generation or upon generation of stockpiles, and specify sample-collection techniques. The plan shall state that a minimum of one sample per 50 cubic yards be collected. Sample densities must also fulfill disposal facility waste acceptance requirements if soil is not to be reused on site. The plan shall specify procedures for decontaminating sampling equipment prior to sampling and between sampling locations. The plan shall also include a requirement for collecting duplicate samples for quality control purposes at a rate of at least 10 percent.

To ensure sample integrity, samples shall be handled using complete chain-of-custody documentation and preserved using proper sample preservation techniques, holding times, and shipment methods. All samples should be identified by unique sample identification (ID) numbers. Samples should be properly labeled and packaged for shipment along with appropriate documentation. Table A–2 lists recommended container types, volume, sample preservation methods, and holding times.

6.2.2 Soil Sample Analysis

Soil samples shall be analyzed in accordance with the Sampling and Analysis Plan that has been reviewed and accepted by an environmental professional and approved by the EH&S Unit. The analytical suite shall be chosen using sound professional judgment and shall reflect the project's needs for data, taking into account the potential contamination present at the project location. All results shall be reported on a dry weight basis and moisture content shall also be reported. Results can be corrected to a wet-weight basis for comparison to waste disposal criteria and California hazardous waste thresholds. Data provided in this SMP are resources to aid the determination of a defensible analytical strategy.

For characterization of soil generated during work conducted in the 0-to-10-foot below ground surface soil horizon, constituents historically detected in concentrations above background (see Table A–1) should be considered in selecting the analytical suite. The list in Table A–1 includes inorganic constituents with statistical test results indicating concentrations above site background, and organic constituents with a detection frequency of 5 percent or more. The list is based on data from soil samples collected between 0 and 10 feet below ground surface (UC Davis 2004).

Attachment A provides more-detailed information about constituents detected in soil in the 0-to-10-foot below ground surface soil horizon. The data in Attachment A represents post-removal-action conditions; however, it may not reflect current conditions for constituents that are subject to degradation, chemical transformation, or transport.

Additional constituents, including constituents of concern identified in the ROD as having a potential impact to human health or groundwater quality, may be present in concentrations above site background in soil below 10 feet. As illustrated in Figure A–6, soil excavated at depths below 10 feet below ground surface can be either shipped off site for disposal or evaluated for on-site reuse. A depth-specific evaluation of existing data may be conducted to determine which constituents should be analyzed in excavated soils. Attachment C provides existing analytical data for soil samples collected at the DOE areas subject to this SMP and data for soil samples collected at background locations. The data in Attachment C contains analytical results for all samples collected between the ground surface and the deepest depth explored. The data in

Attachment C represents post-removal-action conditions; however, it may not reflect current conditions for constituents that are subject to degradation, chemical transformation, or transport.

All samples must be analyzed by a laboratory certified in the State of California and the state of the waste disposal. Analyses performed must meet the requirements of the waste disposal facility if the waste is not to be reused on site.

Table A–2 specifies analytical methods and required detection limits for characterization analyses. The Sampling and Analysis Plan will name the analytical laboratory(ies) that will conduct the analyses, and will provide the laboratory(ies) Quality Assurance Plan, Standard Operating Procedures for the specified analyses, and tables showing reporting limits and MDLs for all analytes. To the extent practical, all reporting limits should meet the detection levels shown on Table A–2. All MDLs must meet these detection levels.

6.2.2.1 Data Quality Assessment

All data generated for the purpose of characterizing excavated soil must be assessed to verify that the data meet the quality requirements in Section 10.2 of the QAPP. A detailed approach to assess data quality shall be specified in the sampling and analysis plans; however, data quality issues that will likely occur for soil sampling data are discussed in this section.
First, the data must be reviewed to verify that they meet the quality objectives specified in Section 7.1 of the Remedial Design/Remedial Action Work Plan. The data shall be valid for determining the disposition of any soil that has been disturbed, including waste segregation, reuse, and disposal requirements. New and existing data will be used to:

- Identify waste segregation strategies;
- Develop appropriate worker health and safety controls;
- Identify materials recycling opportunities; and
- Appropriately dispose of sanitary, hazardous, low-level radioactive, and low-level mixed waste generated during soil-disturbing activities.

Data quality assessment begins with validation of the sample data used in the characterization. The validation shall be performed in accordance with the procedures in SOP 21.1. It should be noted that existing soil data were validated by the Project Chemist with the data qualifications presented in Attachment C.

As part of the validation process, precision and accuracy will be assessed through validation of sample duplicates, calibrations, and spike samples. The parameter that will be used to validate precision is the relative percent difference (RPD). The RPD is used to determine whether a significant difference exists between duplicate samples, including matrix spike duplicates, laboratory control sample duplicates, and field duplicate samples. Other approaches to assessing precision involve statistical calculations or graphical representations that may be conducted after the data are validated. Acceptance limits for the RPDs of matrix spike duplicates, laboratory control sample duplicates, and field duplicates are provided in SOP 21.1.

Accuracy will be assessed through validation of spike recovery and instrument calibration. Acceptance limits for matrix spike recovery, laboratory control sample spike recovery, and calibration parameters provided in SOP 21.1 shall be used. Depending on the analysis method and analyte, a review of linearity in the calibrated range, detector response, reference standards, and continuing calibration check standards shall be performed.

Data representativeness will be achieved through the careful, informed use of existing data and the collection of representative samples to support soil management decisions. Sample locations and rationale will be addressed in the sampling and analysis plans developed before soil-disturbing activities are conducted (see Section 4.1.5) for non-emergency work. Representativeness will also be achieved through the proper collection and handling of samples to avoid interferences and to minimize contamination and loss (see SOPs 1.1, 2.1, and 9.1).

Comparability among measurements will be achieved through the use of standard procedures and standard field data sheets presented in the project SOPs (see Appendix I of the Remedial Design/Remedial Action Work Plan).

The completeness goal for samples collected to support future soil management decisions is 90 percent unless stated otherwise in project-specific work plans. This goal is per analyte per project. If project data are rejected during data validation and the completeness goal is not met, additional samples will be collected, if necessary, to provide sufficient data. When the data are validated and complete, they will be made available to data users for comparisons, calculations, and graphical representations to support project decisions.

Most soil disturbance decisions will rely on comparisons of sample data to background and/or risk-based standards. A screening comparison of maximum concentrations to standards is typically conducted first, followed by the calculation of a statistically representative concentration and/or performance of statistical tests. If a maximum concentration is not accurate and no further statistical approach is taken, the comparison could lead to a project decision error. Part of the data validation process is to identify and assign qualifications to data that may not be accurate. The reason for the data qualification and its impact on the decision should be taken into consideration upon use of single estimated results. If the qualification indicates a high bias or the maximum is not qualified, but appears to be an outlier, the data can be tested according to an outlier test procedure (EPA 2006). Selection of the next-highest concentration may be appropriate depending on the data qualification or outlier test result. Justification for using a second-highest concentration should be provided if it becomes the basis of a project decision.

Statistical representations of the data such as the upper confidence limit on the mean (UCL) can be calculated and used for project decisions. The UCL (typically the 95 percent UCL) may be compared to a risk-based standard, but it should never be compared to the background upper tolerance limit (UTL). The UCL is a representation of central tendency, while the background UTL represents an upper percentile of the background distribution; any comparison between these parameters is biased. Before calculation of a UCL, it is important to evaluate the data distribution using goodness-of-fit tests to determine which distribution assumption is most appropriate. UCLs can be calculated according to a variety of procedures depending on the distribution assumption. It is often the case that data representing contaminated soil do not fit any distribution and are best represented by a non-parametric UCL. ProUCL or other software packages for testing goodness-of-fit and calculating the UCL for data sets with and without non-detect observations may be used (EPA 2009).

Soil data can be compared to background using statistical tests such as the Student's t-Test or Wilcoxon Rank Sum Test. These tests would be used to compare a data set representing onsite soil with a background distribution and determine whether the distributions are shifted relative to one another. A null hypothesis, alternative hypothesis, and decision errors must be specified in the sampling and analysis plan when these tests will be conducted. The hypothesis statement and decision errors for removal actions and confirmation sampling conducted previously in DOE Areas were:

H_o: Reference-based cleanup standard not achieved.

H_a: Reference-based cleanup standard achieved.

Type I decision error: 10 percent

Type II decision error: 20 percent

Where H_o is the null hypothesis, H_a is the alternative hypothesis and "Reference" is the background data set. If the Student's t-Test or other parametric statistical test is selected, goodness-of-fit needs to be tested for the onsite and background data to determine whether the parametric distribution assumption is appropriate. Contaminated soil data rarely pass goodness-of-fit tests, so non-parametric tests such as the Wilcoxon Rank Sum Test are recommended. Non-parametric tests, however, can be insensitive to high concentrations at the upper tail of the onsite distribution (hot spots). A graphical comparison of onsite data to reference data should be included in the evaluation to identify hot spots if a non-parametric test is used.

Other data quality issues include the use of outlier data and censored data. Point-to-point comparisons, parametric estimates, and parametric distribution tests are affected by outlier data. Non-parametric estimates and tests are much less sensitive when outlier data are used. Outlier data can lead to decision error in all cases. Statistical tests are available to determine whether a suspect result qualifies as an outlier (EPA 2006).

Censored data are typically not a problem for point-to-point comparisons, but statistical parameter calculations and distribution tests can yield wrong results if data are highly censored. When results are censored, the reporting limits should be compared to the requirements specified in Table A–2 and Table A–3. Censored data that do not meet the reporting limit requirements may still be usable for project decisions if comparison criteria are above the elevated detection limits. ProUCL has been updated to accommodate UCL calculations using censored data sets (EPA 2009). If data with elevated reporting limits cannot be used, the reason for the reporting limit failure should be determined. Sample matrix/chemistry can cause elevated reporting limits and can be impossible to control. For cases where reporting limits can be controlled, the data set will be evaluated for completeness and the affected samples will be re-analyzed or re-collected, if necessary, to meet the 90 percent completeness goal.

When the point-to-point data comparisons, parameter calculations, or distribution tests are performed, limitations shall be identified and their effect on the comparison or test result explained. The tolerable limits on decision errors shall be verified (see Type I and Type II decision errors discussed above). If a decision error exceeds the tolerable level, the error source shall be identified, if possible, and corrective actions determined, if any.

Table A–3. Required Detection Limits for Organic Constituents

Analyte	Required Detection Limit (µg/kg)	DOE Area
Volatile Organic Compounds		
2-Butanone	10	Ra/Sr, DSS 3, Dry Wells, SWT
Acetone	10	Ra/Sr, DSS 3, DSS 4
Ethylbenzene	10	Ra/Sr, DSS 4, Dry Wells, SWT
Isopropylbenzene	10	DSS 3
Methyl acetate	10	DSS 3
Methylene chloride	10	Ra/Sr, DSS 4
Styrene	10	DSS 3, DSS 4
Toluene	10	Ra/Sr, DSS 3, DSS 4, Dry Wells, SWT
Trichlorofluoromethane	10	DSS 3
Xylenes (total)	10	Ra/Sr, DSS 4, SWT
Semivolatile Organic Compounds		
1,3-Dichlorobenzene	330	DSS 3
1,4-Dichlorobenzene	330	DSS 3, DSS 4
2-Methylnaphthalene	330	DSS 3, DSS 4
Acenaphthene	330	DSS 4
Anthracene	330	DSS 4
Benzaldehyde	800	DSS 3
Benzo(a)anthracene	330	DSS 4
Benzo(a)pyrene	330	DSS 4
Benzo(b)fluoranthene	330	DSS 4
Benzo(ghi)perylene	330	DSS 4
Benzo(k)fluoranthene	330	DSS 4
bis(2-Ethylhexyl)phthalate	330	Ra/Sr, DSS 3, DSS 4
Butylbenzylphthalate	330	DSS 3, DSS 4
Carbazole	330	DSS 4
Chrysene	330	DSS 4
Dibenzo(a,h)anthracene	330	DSS 4
Dibenzofuran	330	DSS 4
Diethylphthalate	330	DSS 3
Di-n-butylphthalate	330	Ra/Sr, DSS 3
Di-n-octylphthalate	330	DSS 3
Fluoranthene	330	DSS 4
Fluorene	330	DSS 4
Hexachlorobenzene	330	DSS 3
Indeno(1,2,3-cd)pyrene	330	DSS 4
Naphthalene	330	DSS 4
Phenanthrene	330	DSS 4
Phenol	330	DSS 4
Pyrene	330	DSS 3, DSS 4
Pesticides/Polychlorinated Biphenyls		
alpha-Chlordane	1.7	Ra/Sr, DSS 3, DSS 4, Dry Wells, EDPs, SWT
gamma-Chlordane	1.7	Ra/Sr, DSS 3, DSS 4, Dry Wells, EDPs, SWT
Heptachlor	1.7	DSS 4, SWT
Heptachlor epoxide	1.7	DSS 4, SWT

Table A–3 (continued). Required Detection Limits for Organic Constituents

Analyte	Required Detection Limit (µg/kg)	DOE Area
4,4'-DDD	3.3	EDPs, SWT
4,4'-DDE	3.3	Ra/Sr, DSS 4, EDPs, SWT
4,4'-DDT	3.3	Ra/Sr, EDPs, SWT
Dieldrin	3.3	DSS 3, EDPs, SWT
Endrin	3.3	EDPs
Endrin aldehyde	3.3	DSS 3
Chlordane	3.3	Ra/Sr, DSS 4, EDPs
Aroclor-1254	33	DSS 3, EDPs

Abbreviations:

µg/kg = micrograms per kilogram
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
Ra/Sr = Radium/Strontium Treatment Systems
DSS 3 = Domestic Septic System 3
DSS 4 = Domestic Septic System 4
Dry Wells = Domestic Septic System Dry Wells A–E
EDPs = Eastern Dog Pens
SWT = Southwest Trenches

Suggestions for improved data collection and statistical evaluation will be provided, as appropriate, for the soil management project. The Project Chemist will identify the source of any failure to meet DQO performance/acceptance criteria and initiate corrective action, if necessary, to prevent future occurrences.

6.2.3 Excavated Soil Designation

Soil designations shall be reviewed and accepted by an environmental professional before the soil is disposed of. Sample data for soil excavated from the 0-to-10-foot below ground surface soil horizon can be compared to the site background levels provided in Table A–4 to determine the soil’s designation. If the concentrations are below site background, the soil can be designated as clean and reused on site. If the contaminant concentrations in soil exceed the background levels listed in the table, an additional comparison to background data distributions, using a statistical test, may be conducted. By definition, 5 percent of uncontaminated soil is statistically expected to contain constituent concentrations above the background levels listed in Table A–4. These background levels are estimates of the 95th percentile of the sample distribution for site soil representative of background conditions. Thus, a soil stockpile may not contain contamination even though some results are above the background levels. Statistical tests such as the Wilcoxon Rank Sum test (Gilbert 1987) can be used to compare excavated soil data to the background data, and can more accurately determine whether excavated soil is contaminated. Additional sample collection may be necessary to meet the statistical power requirement of the test. Statistical tests generally require at least five samples.

Table A–4. Background Values for Metals and Radionuclides Potentially Present in Soil at DOE Areas

Constituent	Shallow[a] Background (mg/kg or pCi/g)	Subsurface[b] Background (mg/kg or pCi/g)	Combined Depths Background (mg/kg or pCi/g)
Metals			
Antimony	NA	NA	1.4
Arsenic	8.14	10.9	NA
Barium	211	294	NA
Beryllium	0.564	0.924	NA
Cadmium	NA	NA	0.51
Chromium	199	125	NA
Cobalt	NA	NA	31
Copper	48.8	61.8	NA
Iron	NA	NA	44,000
Lead	NA	NA	9.5
Manganese	NA	NA	750
Mercury	3.94	0.248	NA
Molybdenum	NA	NA	<0.26
Nickel	334	246	NA
Selenium	NA	NA	1.2
Silver	NA	NA	0.55
Thallium	NA	NA	1.6
Vanadium	66.8	80.3	NA
Zinc	72.4	93.1	NA
Radionuclides			
Actinium-228	0.633	0.642	NA
Americium-241	NA	NA	<0.014
Bismuth-212	0.388	0.434	NA
Bismuth-214	NA	NA	0.54
Carbon-14	NA	NA	<0.13
Cesium-137	0.102	0.00695	NA
Cobalt-60	NA	NA	<0.006
Lead-210	NA	NA	1.6
Lead-212	0.691	0.684	NA
Lead-214	0.55	0.581	NA
Plutonium-241	NA	NA	<0.5
Potassium-40	NA	NA	14
Radium-226	NA	NA	0.752
Radium-228	0.63	0.655	NA
Strontium-90	NA	NA	0.056
Thallium-208	0.204	0.223	NA
Thorium-228	0.627	0.771	NA
Thorium-230	NA	NA	1.04
Thorium-232	0.63	0.8	NA
Thorium-234	NA	NA	0.78
Tritium	NA	NA	<1.2
Uranium-234	0.559	0.706	NA
Uranium-235	NA	NA	0.038
Uranium-238	0.565	0.645	NA

Table A–4 (continued). Background Values for Metals and Radionuclides Potentially Present in Soil at DOE Areas

Constituent	Shallow[a] Background (mg/kg or pCi/g)	Subsurface[b] Background (mg/kg or pCi/g)	Combined Depths Background (mg/kg or pCi/g)
General Chemistry			
Hexavalent Chromium	NA	NA	1.3
Nitrate	NA	NA	36

Notes:
[a] Shallow soil background is representative of soil in the 0-to-4-foot depth interval.
[b] Subsurface soil background is representative of soil deeper than 4 feet below ground surface and less than or equal to approximately 40 feet below ground surface.

Abbreviations:
mg/kg = Milligrams per kilogram
pCi/g = Picocuries per gram
NA = Not applicable
<n = Not detected in background; detection limit of *n*

Other approaches to designating soils as clean or contaminated may be used as long as regulatory approval is obtained for such approaches.

6.3 Waste Disposal

Analytical data and process knowledge shall be used to certify and designate waste as clean, nonhazardous, hazardous, or radioactive, in accordance with applicable federal and State requirements. A designation report containing the technical basis for waste classification in accordance with all applicable regulatory requirements shall be completed to document the designation decision. The report shall be reviewed and accepted by an environmental professional and submitted to the EH&S Unit for review and approval.

All off-site disposal of waste soil will be in a landfill that complies with the Off-Site Rule of Section 121(d)(3) of CERCLA (40 CFR 300.440). The landfill may require specific analytical testing to document that chemical concentrations do not exceed their waste acceptance criteria.

6.3.1 Clean Soil

Clean excavated soil will be reused on site (such as for fill or other construction purposes), to the extent practicable. If on-site reuse is not practical or cost-effective, clean waste soil will be disposed of in a qualifying landfill (see Section 6.3 above).

6.3.2 Nonhazardous Soil

Excavated soil classified as nonhazardous will be disposed of in a Class II or other acceptable landfill, depending on the acceptance criteria of the landfill. Such soil may not have any added radioactivity (i.e., above activities found in background soils). The landfill may require analytical testing of the soil to document that chemical concentrations do not exceed their waste acceptance criteria.

Nonhazardous soil may also be reused on site if a risk assessment can demonstrate that reusing the soil does not pose a risk to human health, the environment, or water quality. At a minimum, the risk assessment must address human health, ecological receptors, groundwater quality, surface water, and the proposed soil reuse scenario (e.g., surface soil layer, subsurface soil layer covered with clean import fill). The risk assessment must be prepared by a qualified professional and evaluate risks of on-site reuse of contaminated soil, taking into account the appropriate site use. A tiered approach should be applied in conducting the risk assessment taking into account the contaminant concentrations, applicable standards, reuse scenarios, volumes of soil to be reused, and other applicable factors. The initial tier of this assessment shall consist of a comparison of the concentrations of chemical and radiological constituents in the soil to applicable risk-based standards (e.g., EPA Region 9 risk-based screening levels [RSLs] or equivalent). DOE, DTSC, and EPA shall approve the risk assessment before the soil may be reused. The soil must be reused in accordance with the risk assessment assumptions.

6.3.3 Hazardous, Radioactive, or Mixed Waste Soil

Soil classified as hazardous and/or containing added radioactivity that fails the risk assessment for reuse on site may be treated on site or be shipped off site for disposal at a facility permitted to accept such soil. Soil removed from the DOE areas subject to this SMP is not expected to be mixed waste or hazardous waste.

On-site treatment shall be conducted only with agency approval and must meet the requirements of the Site Treatment Plan and all applicable laws. On-site treatment may be performed to reduce waste toxicity or consolidate volume prior to disposal. If contaminated soil is disposed of at an off-site location, it will be handled in accordance with the Resource Conservation and Recovery Act, California hazardous waste laws and regulations, and other applicable laws.

A waste profile, containing all associated analytical data and radiological survey data, must be developed for the soil or excavated waste to be shipped off site for disposal. The profile shall compare waste characterization data to the disposal facility waste acceptance criteria to determine if the acceptance criteria are met.

Radioactive or mixed waste soil will be disposed of in facilities licensed to accept low-level radioactive and mixed wastes, respectively. DOE must approve the disposal before the material is moved off site.

Soil with added radioactivity may also be reused on site if a risk assessment can demonstrate that reusing the soil does not pose a risk to human health, the environment, or water quality. At a minimum, the risk assessment must address human health, ecological receptors, groundwater quality, and surface water for the proposed soil reuse scenario (e.g., surface soil layer, subsurface soil layer covered with clean import fill). DOE, DTSC, and EPA shall approve the risk assessment before the soil may be reused. All signatories to the ROD will be provided the opportunity to review and comment on the risk assessment. The soil must be reused in accordance with the risk assessment assumptions.

7.0 Inspections

As frequently as appropriate for the work being performed, the EH&S Unit shall inspect active excavation, digging, or other soil-disturbing activities authorized by the EH&S Unit to ensure that they comply with this SMP. Stop-work orders shall be promptly issued if any noncompliance has occurred. An investigation shall be conducted to determine the cause of, and parties responsible for, any noncompliance before work activities resume.

DOE and all signatories to the ROD shall be promptly notified of the findings of the investigation if the occurrence put human health or the environment at risk.

Evidence of unauthorized soil disturbance shall be documented and reported to DOE, DTSC, and EPA within 30 days of its identification. Corrective action, if required, shall be developed in coordination with DOE, DTSC, EPA, other signatories to the ROD as appropriate, and the EH&S Unit.

8.0 Documentation

8.1 Recordkeeping

The following documentation must be maintained and submitted to the EH&S Unit for all soil-disturbing projects:

- Work Plans
- Analytical data
- Soil designation reports
- Hazardous waste manifests
- Manifest fee documents
- Bills of Lading for Disposal

8.2 Soil Disturbance Reports

A soil disturbance report shall be submitted to the EH&S Unit at the completion of soil-disturbing activities. At a minimum, the report shall include:

- A description of work performed;
- A map, with the project location and location(s) of soil disturbance, soil removal, soil reuse, and/or placement of imported soil;
- A map of waste storage and stockpile locations;
- A map of sampling locations, as appropriate;
- Contaminants of concern;
- EPA analytical methods;
- Analytical data results, including associated laboratory quality control reports;

- A risk assessment with a recommended course of action;
- Waste characterization data;
- Waste profiles and manifests for soil disposed of at off-site disposal facilities;
- Volumes of soil reused on site along with surveyed coordinates indicating the location(s) where such soil was placed; and
- Analytical data for an imported soil placed on site.

8.3 Annual Reports

Per the requirements of the ROD and as described in the RD/RAWP, DOE shall submit a written land-use covenant report to all ROD signatories annually. Reports shall be submitted within 30 days of the anniversary date of the ROD signature date and shall include:

- Inspection results;
- A certification attesting to compliance with the terms and conditions of the land-use covenant; and
- A discussion of any soil-disturbing activities and the final disposal of any wastes generated, any violations of the land-use covenant, and any action taken to ensure compliance with the land-use covenant.

These reports shall discuss SMP implementation and summarize the data and information described in Sections 8.1 and 8.2 above.

8.4 Audits

DOE shall audit the implementation of this SMP as needed but no less frequently than every 5 years. The audit shall review:

- Compliance with this SMP,
- Safety documentation,
- Soil reuse approvals,
- Waste disposal records, and
- Incidents and corrective actions.

The results of the audits shall be included in 5-year reviews.

8.5 5-Year Reviews

Sites that have remaining hazardous substances, pollutants, or contaminants above levels that allow for unlimited use and unrestricted exposure after remedial actions must be reviewed every 5 years to ensure protection of human health and the environment. DOE will conduct a 5-year review in accordance with the requirement provided in the RD/RAWP, as well as any regulations, policies, and guidance applicable at the time. Any recommended SMP modification will be addressed during these reviews.

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Attachment A

Tables of Contaminants Detected at Concentrations Above Site Background (0−10 Feet Below Ground Surface)

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Attachment A Table 1. Contaminants Detected at Concentrations Above Background in the Radium/Strontium Treatment Systems Area, 0 to 10 Feet Below Ground Surface

Constituent	Samples	Detections	Detections Above Background	Sample ID Number of Maximum Concentration	Concentration Range	Detection Limit Range	Surface/Subsurface Soil Background[a]	Units	Depth of Maximum (feet)
2-Butanone	78	25	25	SSRSC005	1.4–132	5.1–53	0	µg/kg	10
4,4'-DDE	78	5	5	SSRSC021	0.34–3.2	3.6–193	0	µg/kg	2
4,4'-DDT	78	14	14	SSRSC066	0.39–133	3.6–193	0	µg/kg	3
Acetone	78	10	10	SSRSC036	2.88–36.3	5.3–52.6	0	µg/kg	10
Alpha-Chlordane	78	32	32	SSRSC066	0.39–277	1.8–96.6	0	µg/kg	3
Americium-241	84	22	3	SSRSC053	0.00243–0.0847	0.00114–0.031	0.014	pCi/g	8
Barium	78	78	3	SSRSC075	84.7–317	0.018–44.6	211 / 294	mg/kg	6
Bis(2-ethylhexyl)phthalate	83	27	27	SSRSC022	21.6–198	344–6940	0	µg/kg	5
Cadmium	78	26	5	SSRSC072	0.095–1.4	0.034–1.1	0.51	mg/kg	6
Carbon-14	85	16	5	SSRSC019	0.0707–2.38	0.0641–0.104	0.13	pCi/g	8
Chlordane	18	15	15	CWRSC036	4–28	172–687	0	µg/kg	3
Copper	78	78	7	SSRSC072	19.9–182	0.15–5.6	48.8 / 61.8	mg/kg	6
Di-n-butylphthalate	83	13	13	SSRSC065	8.8–380	344–6940	0	µg/kg	1.5
Ethylbenzene	78	21	21	SSRSB010	0.55–1.6	1–12.7	0	µg/kg	1
gamma-Chlordane	78	32	32	SSRSC066	0.65–346	1.8–96.6	0	µg/kg	3
Hexavalent Chromium	79	60	0	SSRSC070	0.0624–0.841	0.036–0.541	1.3	mg/kg	7
Iron	60	60	1	SSRSC075	16500–45400	0.47–22.3	44000	mg/kg	6
Methylene chloride	78	70	70	SSRSC072	0.53–7.04	5.1–53	0	µg/kg	6
Plutonium-241	84	10	5	SSRSC073	0.335–1.32	0.286–0.539	0.5	pCi/g	6
Selenium	78	70	26	SSRSB009	0.52–2.1	0.27–1.1	1.2	mg/kg	1
Silver	77	43	22	CWRSC046	0.14–4.6	0.085–2.2	0.55	mg/kg	3
Strontium-90	89	41	25	SSRSC043	0.0151–2.18	0.0124–0.22	0.056	pCi/g	5
Thallium	78	4	2	SSRSB010	1.2–1.9	0.37–2.2	1.6	mg/kg	1
Thorium-228	84	84	13	SSRSC076	0.314–1.12	0.045–0.674	0.627 / 0.771	pCi/g	2
Toluene	78	68	68	SSRSC059	0.625–263	1–56.2	0	µg/kg	10
Vanadium	78	78	12	SSRSC075	30.3–84.9	0.0728–11.2	66.8 / 80.3	mg/kg	6
Xylenes (total)	78	37	37	SSRSB010	0.678–9.4	3.1–38	0	µg/kg	1
Zinc	78	78	20	SSRSC072	36.4–151	0.053–4.5	72.4 / 93.1	mg/kg	6

Attachment A Table 1 (continued). Contaminants Detected at Concentrations Above Background in the Radium/Strontium Treatment Systems Area, 0 to 10 Feet Below Ground Surface

Notes:
Concentrations reflect post-removal-action conditions.
Includes inorganic constituents with statistical test results indicating above-background concentrations in soil from 0 to 10 feet below ground surface (UC Davis 2004).
Includes organic constituents with detection frequency of 5 percent or more in soil from 0 to 10 feet below ground surface (SWRA Table 2 [UC Davis 2004]).
Copy of soil data provided in Attachment C.
[a] Background values for surface soil (0 to 4 feet below ground surface) and subsurface soil (greater than 4 feet below ground surface) provided for constituents with statistically significant vertical stratification (Weiss 2000). Single background value provided for non-stratified constituents.

Abbreviations:
µg/kg = micrograms per kilogram
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram
pCi/g = picocuries per gram
SWRA = Site-Wide Risk Assessment

Attachment A Table 2. Contaminants Detected at Concentrations Above Background in the Domestic Septic System 3, 0 to 10 Feet Below Ground Surface

Constituent	Samples	Detections	Detections Above Background	Sample ID Number of Maximum Concentration	Concentration Range	Detection Limit Range	Surface/Subsurface Soil Background[a]	Units	Depth of Maximum (feet)
1,3-Dichlorobenzene	10	1	1	SSIBF155	0.286–0.286	9.6–367	0	µg/kg	6.5
1,4-Dichlorobenzene	10	2	2	CSD3C001	0.579–0.819	9.6–367	0	µg/kg	9
2-Butanone	10	2	2	LEHR-S-T304	2.55–4	9.6–12	0	µg/kg	8
2-Methylnaphthalene	10	7	7	SSD3C024	0.34–0.8	333–709	0	µg/kg	8
Acetone	10	3	3	CSD3C001	6.46–30.9	9.6–12	0	µg/kg	9
alpha-Chlordane	26	18	18	SSD3C047DL	0.063–161	1.7–38.2	0	µg/kg	5.9
Aroclor-1254	7	2	2	SSD3C024	21.7–225	33.3–69.4	0	µg/kg	8
Benzaldehyde	8	2	2	SSD3C024	15.6–53.8	333–709	0	µg/kg	8
bis(2-Ethylhexyl)phthalate	10	10	10	SSD3C036	11.5–101	333–709	0	µg/kg	5.5
Butylbenzylphthalate	10	3	3	SSD3C030	0.59–5.5	333–709	0	µg/kg	7
Cesium-137	31	7	5	LEHR-S-T301	0.0049–0.126	0.00209–0.053	0.102 / 0.00695	pCi/g	8
Dieldrin	7	1	1	SSIBF156	2.4–2.4	3.3–19.8	0	µg/kg	4.5
Diethylphthalate	10	4	4	SSD3C030	0.6–1.2	333–709	0	µg/kg	7
Di-n-butylphthalate	10	7	7	SSD3C036	2.9–20.6	333–709	0	µg/kg	5.5
Di-n-octylphthalate	10	1	1	SSIBF155	0.49–0.49	333–709	0	µg/kg	6.5
Endrin aldehyde	7	1	1	SSIBF156	0.35–0.35	3.3–6.9	0	µg/kg	4.5
Formaldehyde	20	19	19	SSD3C041	0.21–1.3	0.1–0.11	0	mg/kg	5.9
gamma-Chlordane	26	20	20	SSD3C047DL	0.13–294	1.7–38.2	0	µg/kg	5.9
Hexachlorobenzene	10	1	1	SSD3C024	125–125	333–709	0	µg/kg	8
Isopropylbenzene	8	1	1	SSIBF155	1.47–1.47	9.6–11.8	0	µg/kg	6.5
Lead-210	31	10	1	LEHR-S-T301	0.48–4.4	0.0691–1.76	1.6	pCi/g	8
Methyl acetate	8	1	1	SSD3C028	3.4–3.4	9.6–11.8	0	µg/kg	6
Pyrene	10	2	2	SSD3C025	0.81–3.3	333–709	0	µg/kg	8
Strontium-90	25	15	12	SSD3C062	0.0281–0.591	0.0154–0.0661	0.056	pCi/g	5.2
Styrene	10	1	1	SSIBF155	0.326–0.326	9.6–12	0	µg/kg	6.5
Thallium	10	3	2	CSD3C001	1.1–2.8	0.87–5.1	1.6	mg/kg	9
Toluene	10	7	7	SSD3C019	0.638–74.7	9.6–12	0	µg/kg	10
Trichlorofluoromethane	8	1	1	SSIBF155	1.18–1.18	9.6–11.8	0	µg/kg	6.5
Zinc	10	10	1	LEHR-S-T301	37.9–258	0.1–4.3	72.4 / 93.1	mg/kg	8

Attachment A Table 2 (continued). Contaminants Detected at Concentrations Above Background in the Domestic Septic System 3, 0 to 10 Feet Below Ground Surface

Notes:
Concentrations reflect post-removal-action conditions.
Includes inorganic constituents with statistical test results indicating above-background concentrations in soil from 0 to 10 feet below ground surface (UC Davis 2004).
Includes organic constituents with detection frequency of 5 percent or more in soil from 0 to 10 feet below ground surface (SWRA Table 2 [UC Davis 2004]).
Copy of soil data provided in Attachment C.
[a]Background values for surface soil (0 to 4 feet below ground surface) and subsurface soil (greater than 4 feet below ground surface) provided for constituents with statistically significant vertical stratification (Weiss 2000). Single background value provided for non-stratified constituents.

Abbreviations:

µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
pCi/g	picocuries per gram
SWRA	Site-Wide Risk Assessment

Attachment A Table 3. Contaminants Detected at Concentrations Above Background in the Domestic Septic System 4, 0 to 10 Feet Below Ground Surface

Constituent	Samples	Detections	Detections Above Background	Sample ID Number of Maximum Concentration	Concentration Range	Detection Limit Range	Surface/Subsurface Soil Background[a]	Units	Depth of Maximum (feet)
1,4-Dichlorobenzene	6	2	2	SSD4C003A/B	3.2–4.1	350–360	0	µg/kg	4.2
2-Methylnaphthalene	6	2	2	SSD4C003A/B	8.8–56.7	350–360	0	µg/kg	4.2
4,4'-DDE	5	1	1	SSD4C005	8.1–8.1	3.5–35.8	0	µg/kg	4.2
Acenaphthene	6	2	2	SSD4C003A/B	71.4–342	350–360	0	µg/kg	4.2
Acetone	6	3	3	LEHR-S-T405	2.05–23	10.5–26.4	0	µg/kg	8.5
Alpha-Chlordane	5	2	2	SSD4C003A/B	16.7–179	1.8–18.3	0	µg/kg	4.2
Anthracene	6	3	3	SSD4C003A/B	11.7–1160	350–360	0	µg/kg	4.2
Benzo(a)anthracene	6	3	3	SSD4C003A/B	50.3–3760	350–360	0	µg/kg	4.2
Benzo(a)pyrene	6	3	3	SSD4C003A/B	38.8–2380	350–360	0	µg/kg	4.2
Benzo(b)fluoranthene	6	3	3	SSD4C002A/B	35.7–2700	350–360	0	µg/kg	4.2
Benzo(ghi)perylene	6	3	3	SSD4C002A/B	26.4–1750	350–360	0	µg/kg	4.2
Benzo(k)fluoranthene	6	3	3	SSD4C003A/B	40–1530	350–360	0	µg/kg	4.2
Bis(2-Ethylhexyl)phthalate	6	6	6	SSD4C001	36.2–440	350–360	0	µg/kg	7.8
Butylbenzylphthalate	6	1	1	SSD4C002A/B	13.1–13.1	350–360	0	µg/kg	4.2
Carbazole	6	2	2	SSD4C003A/B	88.8–486	350–360	0	µg/kg	4.2
Chlordane	1	1	1	SSD4C005	181–181	89.6–89.6	0	µg/kg	4.2
Chromium	6	6	6	LEHR-S-T402	159–319	0.061–2.1	199 / 125	mg/kg	8
Chrysene	6	3	3	SSD4C003A/B	53.7–3010	350–360	0	µg/kg	4.2
Dibenzo(a,h)anthracene	6	2	2	SSD4C002A/B	9.1–1080	350–360	0	µg/kg	4.2
Dibenzofuran	6	2	2	SSD4C003A/B	33.2–187	350–360	0	µg/kg	4.2
Ethylbenzene	6	1	1	SSD4C004	0.882–0.882	1–12	0	µg/kg	7.75
Fluoranthene	6	3	3	SSD4C003A/B	80–2900	350–360	0	µg/kg	4.2
Fluorene	6	3	3	SSD4C003A/B	3.6–507	350–360	0	µg/kg	4.2
gamma-Chlordane	5	3	3	SSD4C003A/B	1–275	1.8–18.3	0	µg/kg	4.2
Heptachlor	5	1	1	SSD4C003A/B	5.8–5.8	1.8–18.3	0	µg/kg	4.2
Heptachlor Epoxide	5	1	1	SSD4C003A/B	10.7–10.7	1.8–18.3	0	µg/kg	4.2
Indeno(1,2,3-cd)pyrene	6	2	2	SSD4C003A/B	431–1470	350–360	0	µg/kg	4.2
Lead-210	6	3	1	LEHR-S-T401	0.434–4.7	0.0352–1.3	1.6	pCi/g	5.5
Methylene Chloride	6	4	4	SSD4C003A/BDL	2.89–457	5.3–53.8	0	µg/kg	4.2
Naphthalene	6	2	2	SSD4C003A/B	13.3–70.5	350–360	0	µg/kg	4.2

Attachment A Table 3 (continued). Contaminants Detected at Concentrations Above Background in the Domestic Septic System 4, 0 to 10 Feet Below Ground Surface

Constituent	Samples	Detections	Detections Above Background	Sample ID Number of Maximum Concentration	Concentration Range	Detection Limit Range	Surface/Subsurface Soil Background[a]	Units	Depth of Maximum (feet)
Phenanthrene	6	3	3	SSD4C003A/B	37.4–2880	350–360	0	µg/kg	4.2
Pyrene	6	3	3	SSD4C003A/B	75.3–5110	350–360	0	µg/kg	4.2
Selenium	6	2	2	SSD4C003A/B	1.23–2	0.376–0.74	1.2	mg/kg	4.2
Strontium-90	6	0	0	NA	NA	0.028–0.47	0.056	pCi/g	NA
Styrene	6	1	1	SSD4C004	0.673–0.673	1–12	0	µg/kg	7.75
Toluene	6	3	3	SSD4C001DL	1.52–197	1–52.9	0	µg/kg	7.8
Xylenes (Total)	6	2	2	SSD4C004	1.02–5.6	2.1–32.3	0	µg/kg	7.75

Notes:
Concentrations reflect current conditions. No removal actions have been conducted.
Includes inorganic constituents with statistical test results indicating above-background concentrations in soil from 0 to 10 feet below ground surface (UC Davis 2004).
Includes organic constituents with detection frequency of 5 percent or more in soil from 0 to 10 feet below ground surface. SWRA Table 2 (UC Davis 2004).
Copy of soil data provided in Attachment C.
[a]Background values for surface soil (0 to 4 feet below ground surface) and subsurface soil (greater than 4 feet below ground surface) provided for constituents with statistically significant vertical stratification (Weiss 2000). Single background value provided for non-stratified constituents.

Abbreviations:
µg/kg = micrograms per kilogram
DDE = dichlorodiphenyldichloroethylene
mg/kg = milligrams per kilogram
NA = not applicable
pCi/g = picocuries per gram
SWRA = Site-Wide Risk Assessment

Attachment A Table 4. Contaminants Detected at Concentrations Above Background in the Dry Wells A–E Area, 0 to 10 Feet Below Ground Surface

Constituent	Samples	Detections	Detections Above Background	Sample ID Number of Maximum Concentration	Concentration Range	Detection Limit Range	Surface/Subsurface Soil Background[a]	Units	Depth of Maximum (feet)
2-Butanone	9	5	5	SSSTC011	7–70	11.4–20	0	µg/kg	5
Alpha-Chlordane	9	4	4	SSSTC008	0.77–6.2	1.9–2.2	0	µg/kg	8
Arsenic	13	13	0	SSSTC006	5.9–10.8	0.56–2.4	8.14 / 10.9	mg/kg	5
Barium	13	13	0	SSDWC022	148–253	0.053–49.2	211 / 294	mg/kg	10
Beryllium	13	13	0	SSDWC023	0.31–0.58	0.046–1.2	0.564 / 0.924	mg/kg	10
Carbon-14	10	1	0	SSSTC006	0.0915–0.0915	0.0768–0.53	0.13	pCi/g	5
Cobalt-60	10	0	0	NA	NA	0.00499–0.051	0.006	pCi/g	NA
Copper	13	13	0	SSDWC023	30.5–52.4	0.22–6.1	48.8 / 61.8	mg/kg	10
Ethylbenzene	9	4	4	SSSTC011	0.749–2.24	5–12.6	0	µg/kg	5
Gamma-Chlordane	9	4	4	SSSTC008	0.76–6.7	1.9–2.2	0	µg/kg	8
Iron	13	13	0	SSSTC006	30200–40300	0.48–24.6	44000	mg/kg	5
Radium-226	10	10	0	SSSTC005	0.43–0.675	0.0298–0.3	0.752	pCi/g	6
Selenium	13	5	1	SSDWC027	0.79–1.7	0.58–1.2	1.2	mg/kg	10
Silver	13	9	7	SSDWC027	0.47–27.6	0.14–2.4	0.55	mg/kg	10
Strontium-90	10	4	3	SSSTC006	0.0521–0.153	0.0355–0.51	0.056	pCi/g	5
Thorium-228	7	7	0	SSSTC006	0.604–0.771	0.162–0.408	0.627 / 0.771	pCi/g	5
Thorium-232	7	7	1	SSSTC006	0.325–0.875	0.0303–0.153	0.63 / 0.8	pCi/g	5
Thorium-234	10	7	1	SSSTC005	0.502–0.899	0.0908–1.5	0.78	pCi/g	6
Toluene	9	6	6	SSSTC008	1.47–214	5–24.4	0	µg/kg	8
Uranium-233/234	7	7	0	SSSTC006	0.486–0.57	0.00231–0.012	0.559 / 0.706	pCi/g	5
Uranium-238	7	7	0	SSSTC006	0.461–0.599	0.00231–0.0103	0.565 / 0.645	pCi/g	5
Vanadium	13	13	1	SSDWC023	56.8–82.9	0.1–12.3	66.8 / 80.3	mg/kg	10
Zinc	13	13	1	LEHR-S-T1A01(5.0)	70.3–136	0.11–4.9	72.4 / 93.1	mg/kg	5

Attachment A Table 4 (continued). Contaminants Detected at Concentrations Above Background in the Dry Wells A–E Area, 0 to 10 Feet Below Ground Surface

Notes:
Concentrations reflect post-removal-action conditions.
Includes inorganic constituents with statistical test results indicating above-background concentrations in soil from 0 to 10 feet below ground surface (UC Davis 2004).
Includes organic constituents with detection frequency of 5 percent or more in soil from 0 to 10 feet below ground surface. SWRA Table 2 (UC Davis 2004).
Copy of soil data provided in Attachment C.
[a]Background values for surface soil (0 to 4 feet below ground surface) and subsurface soil (greater than 4 feet below ground surface) provided for constituents with statistically significant vertical stratification (Weiss 2000). Single background value provided for non-stratified constituents.

Abbreviations:

µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
NA	not applicable
pCi/g	picocuries per gram
SWRA	Site-Wide Risk Assessment

Attachment A Table 5. Contaminants Detected at Concentrations Above Background in the Southwest Trenches Area, 0 to 10 Feet Below Ground Surface

Constituent	Samples	Detections	Detections Above Background	Sample ID Number of Maximum Concentration	Concentration Range	Detection Limit Range	Surface/Subsurface Soil Background[a]	Units	Depth of Maximum (feet)
2-Butanone	66	8	8	SSDTC049	3.92–548	10–56.2	0	µg/kg	4
4,4'-DDD	80	36	36	LEHR-S-486	0.033–99	0.73–360	0	µg/kg	3
4,4'-DDE	80	29	29	SSDTC062	0.065–26.8	0.73–35.1	0	µg/kg	4
4,4'-DDT	80	35	35	SSDTC041DL1	2.2–276	0.73–36.5	0	µg/kg	6
Alpha-Chlordane	98	71	71	LEHR-S-484	0.032–1700	0.36–180	0	µg/kg	3.5
Americium-241	51	4	2	SSDTC025	0.00431–0.0378	0.00288–0.027	0.014	pCi/g	3
Antimony	66	31	1	SSDTC069	0.28–1.5	0.49–14	1.4	mg/kg	4
Barium	66	66	1	SSDTC087	111–286	9.7–46.6	211 / 294	mg/kg	10
Carbon-14	68	28	26	SSDTC024	0.111–5.84	0.0899–11	0.13	pCi/g	3
Cesium-137	97	14	4	SSDTC036	0.0219–1.18	0.00542–0.054	0.102 / 0.00695	pCi/g	6
Cobalt-60	95	0	0	NA	NA	0.0139–0.062	0.006	pCi/g	NA
Dieldrin	80	6	6	LEHR-S-484	0.41–70	0.73–35.1	0	µg/kg	3.5
Ethylbenzene	66	13	13	SSDTC048	0.577–2.87	1.1–56.2	0	µg/kg	6
Formaldehyde	14	1	1	LEHR-S-482	1.4–1.4	1–1	0	mg/kg	3
gamma-Chlordane	98	73	73	LEHR-S-484	0.12–1900	0.36–180	0	µg/kg	3.5
Heptachlor	80	22	22	LEHR-S-486	0.2–96	0.36–17.5	0	µg/kg	3
Heptachlor Epoxide	80	9	9	SSDTC004	0.87–3.8	0.36–17.5	0	µg/kg	3
Hexavalent Chromium	95	77	0	SSDTC052	0.0474–1.06	0.182–0.5	1.3	mg/kg	4
Iron	66	66	1	SSDTC067	21000–44200	19.5–220	44000	mg/kg	8
Lead-210	95	11	2	SSDTF370	0.261–7.17	0.194–8.89	1.6	pCi/g	1.5
Plutonium-241	52	6	1	SSDTC020	0.338–0.517	0.268–0.478	0.5	pCi/g	3
Selenium	66	17	2	SSDTC090	0.58–1.4	0.47–1.1	1.2	mg/kg	0
Silver	66	8	2	SSDTC052	0.4–0.75	0.4–2.3	0.55	mg/kg	4
Strontium-90	94	24	23	SSDTC066	0.0498–2.62	0.0236–0.5	0.056	pCi/g	7
Thorium-228	52	52	5	SSDTC076	0.336–0.894	0.0544–0.387	0.627 / 0.771	pCi/g	5
Toluene	66	33	33	SSDTC056	0.723–438	1.1–56.2	0	µg/kg	5
Tritium	53	9	8	SSDTC065	0.971–2.93	0.721–1.18	1.2	pCi/g	10
Vanadium	66	66	5	SSDTC079	41–83.9	0.97–11.6	66.8 / 80.3	mg/kg	8
Xylenes (Total)	80	39	39	SSDTC075R	0.534–16.4	1.1–56.2	0	µg/kg	3
Zinc	66	66	6	SSDTC020	48.6–150	3.9–4.6	72.4 / 93.1	mg/kg	3

Attachment A Table 5 (continued). Contaminants Detected at Concentrations Above Background in the Southwest Trenches Area, 0 to 10 Feet Below Ground Surface

Notes:
Concentrations reflect post-removal-action conditions.
Includes inorganic constituents with statistical test results indicating above-background concentrations in soil from 0 to 10 feet below ground surface (UC Davis 2004).
Includes organic constituents with detection frequency of 5 percent or more in soil from 0 to 10 feet below ground surface. SWRA Table 2 (UC Davis 2004).
Copy of soil data provided in Attachment C.
[a] Background values for surface soil (0 to 4 feet below ground surface) and subsurface soil (greater than 4 feet below ground surface) provided for constituents with statistically significant vertical stratification (Weiss 2000). Single background value provided for non-stratified constituents.

Abbreviations:
µg/kg = micrograms per kilogram
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram
NA = not applicable
pCi/g = picocuries per gram
SWRA = Site-Wide Risk Assessment

Attachment A Table 6. Contaminants Detected at Concentrations Above Background in the Eastern Dog Pens Area

Constituent	Samples	Detections	Detections Above Background	Sample ID Number of Maximum Concentration	Concentration Range	Detection Limit Range	Surface/Subsurface Soil Background[a]	Units	Depth of Maximum (feet)
4,4'-DDD	36	7	7	SSDP0343	0.82–3.3	3.4–4.2	0	µg/kg	1.02
4,4'-DDE	36	3	3	SSDP0330	0.3–3.6	3.4–4.2	0	µg/kg	2.01
4,4'-DDT	36	5	5	SSDP0318	0.48–5.8	3.4–4.2	0	µg/kg	1.17
Alpha-Chlordane	36	12	12	SSDP0346DL1	0.38–47.8	1.7–3.7	0	µg/kg	0.02
Aroclor-1254	37	2	2	SSDP0319	24.3–54.9	34–42.2	0	µg/kg	1.17
Chromium	37	37	3	SSDP0336	90.7–251	2–2.4	199 / 125	mg/kg	0.96
Cobalt-60	37	0	0	NA	NA	0.00463–0.00773	0.006	pCi/g	NA
Dieldrin	37	13	13	SSDP0338DL1	0.76–223	3.4–18.1	0	µg/kg	0
gamma-Chlordane	36	12	12	SSDP0346DL1	0.4–43.4	1.7–3.7	0	µg/kg	0.02
Hexavalent Chromium	37	36	0	SSDP0320	0.077–0.673	0.204–0.254	1.3	mg/kg	3.17
Lead-210	37	10	0	SSDP0334	0.356–1.33	0.0656–2.09	1.6	pCi/g	0.41
Strontium-90	53	14	7	GSDP0004	0.023–0.201	0.0143–0.0493	0.056	pCi/g	1.5
Tritium	42	0	0	NA	NA	0.874–1.18	1.2	pCi/g	NA

Notes:
Concentrations reflects current conditions after completion of a maintenance action to remove all concrete materials from the area.
Includes inorganic constituents with statistical test results indicating above-background concentrations in soil from 0 to 10 feet below ground surface (UC Davis 2004).
Includes organic constituents with detection frequency of 5 percent or more in soil from 0 to 10 feet below ground surface. SWRA Table 2 (UC Davis 2004).
Copy of soil data provided in Attachment C.
[a] Background values for surface soil (0 to 4 feet below ground surface) and subsurface soil (greater than 4 feet below ground surface) provided for constituents with statistically significant vertical stratification (Weiss 2000). Single background value provided for non-stratified constituents.

Abbreviations:
µg/kg = micrograms per kilogram
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram
NA = not applicable
pCi/g = picocuries per gram
SWRA = Site-Wide Risk Assessment

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Attachment B

Soil Sample Location Figures

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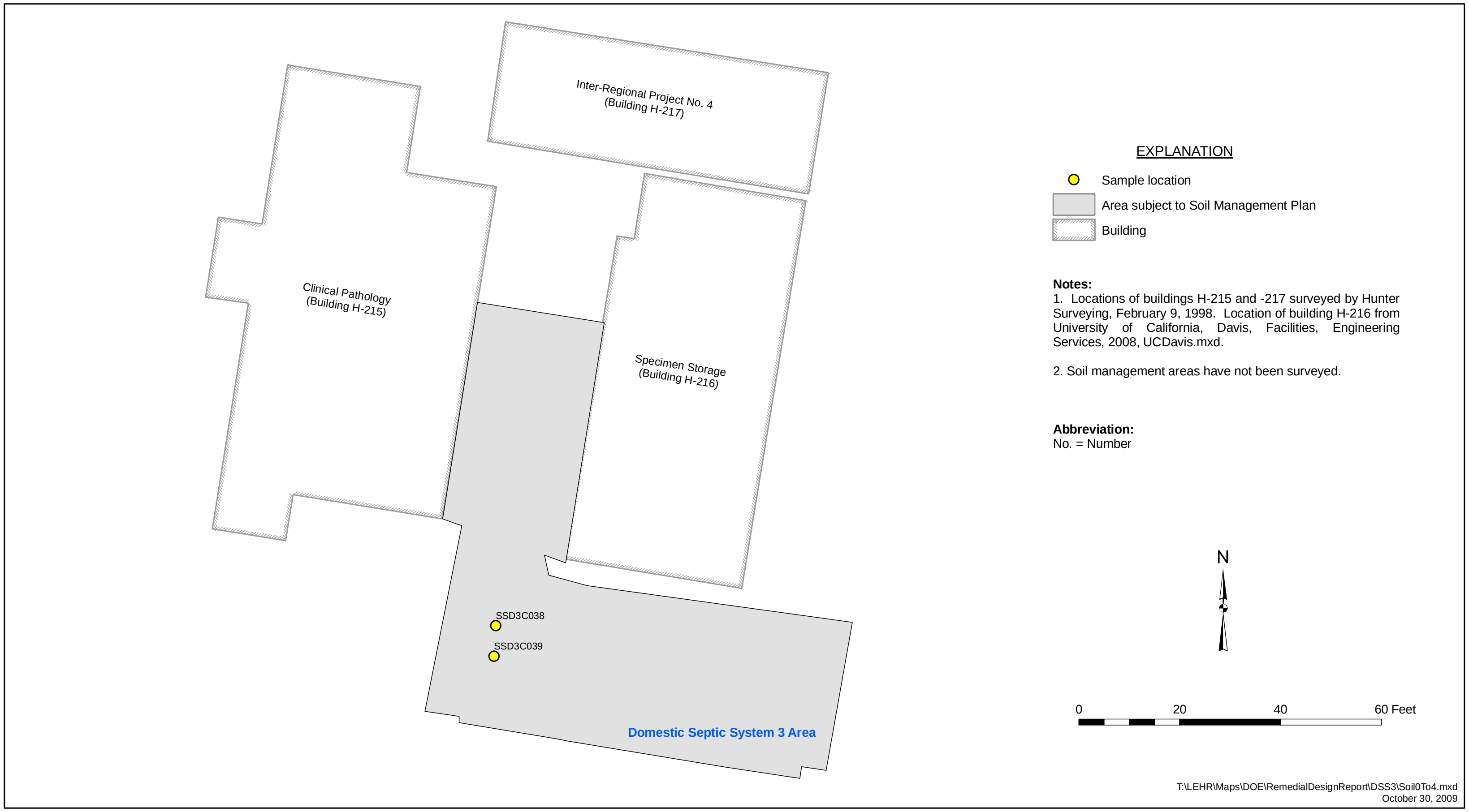
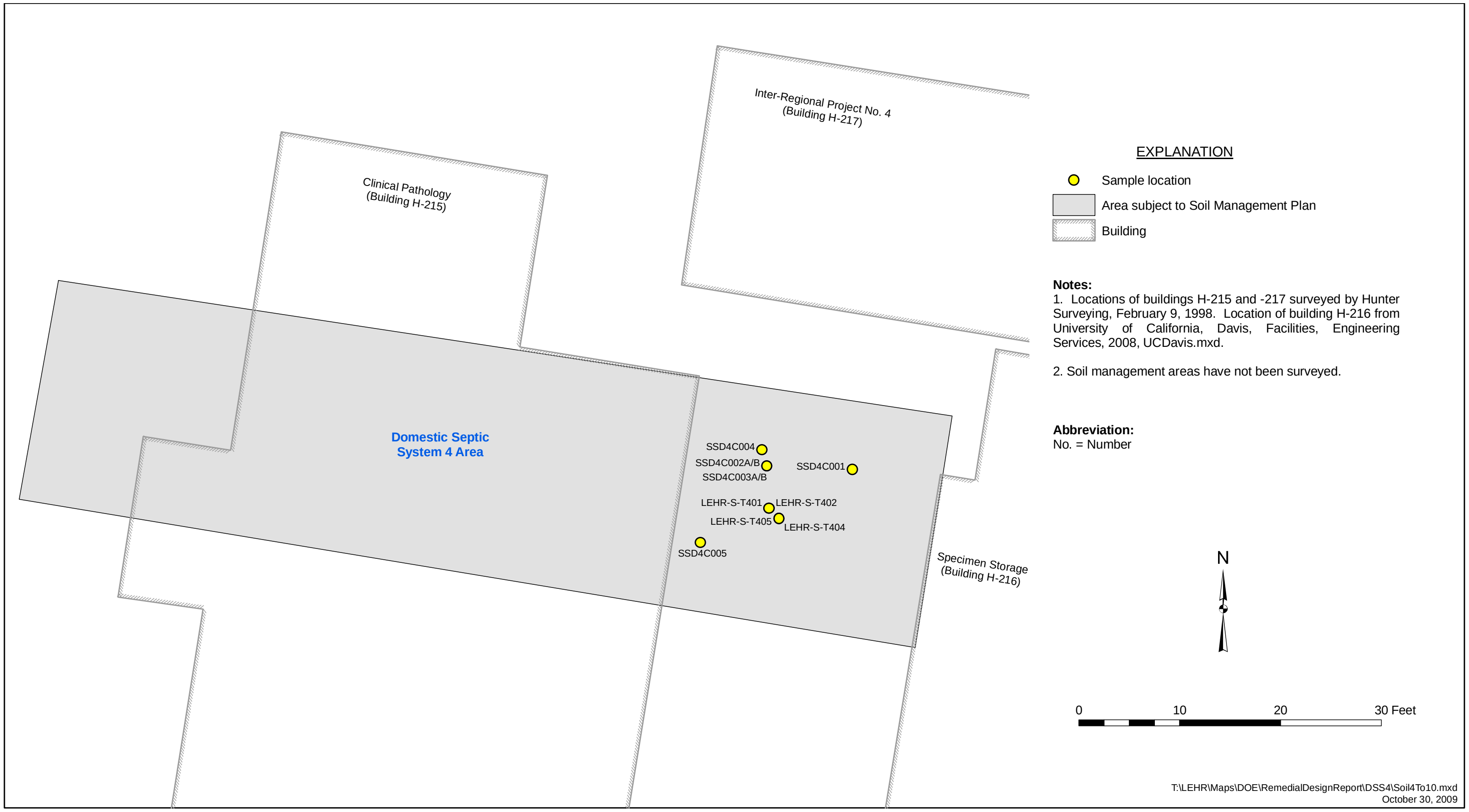


Attachment B Figure 1. Soil Sample Locations for the Domestic Septic System 3 Area (0 to 4 Feet Below Ground Surface)

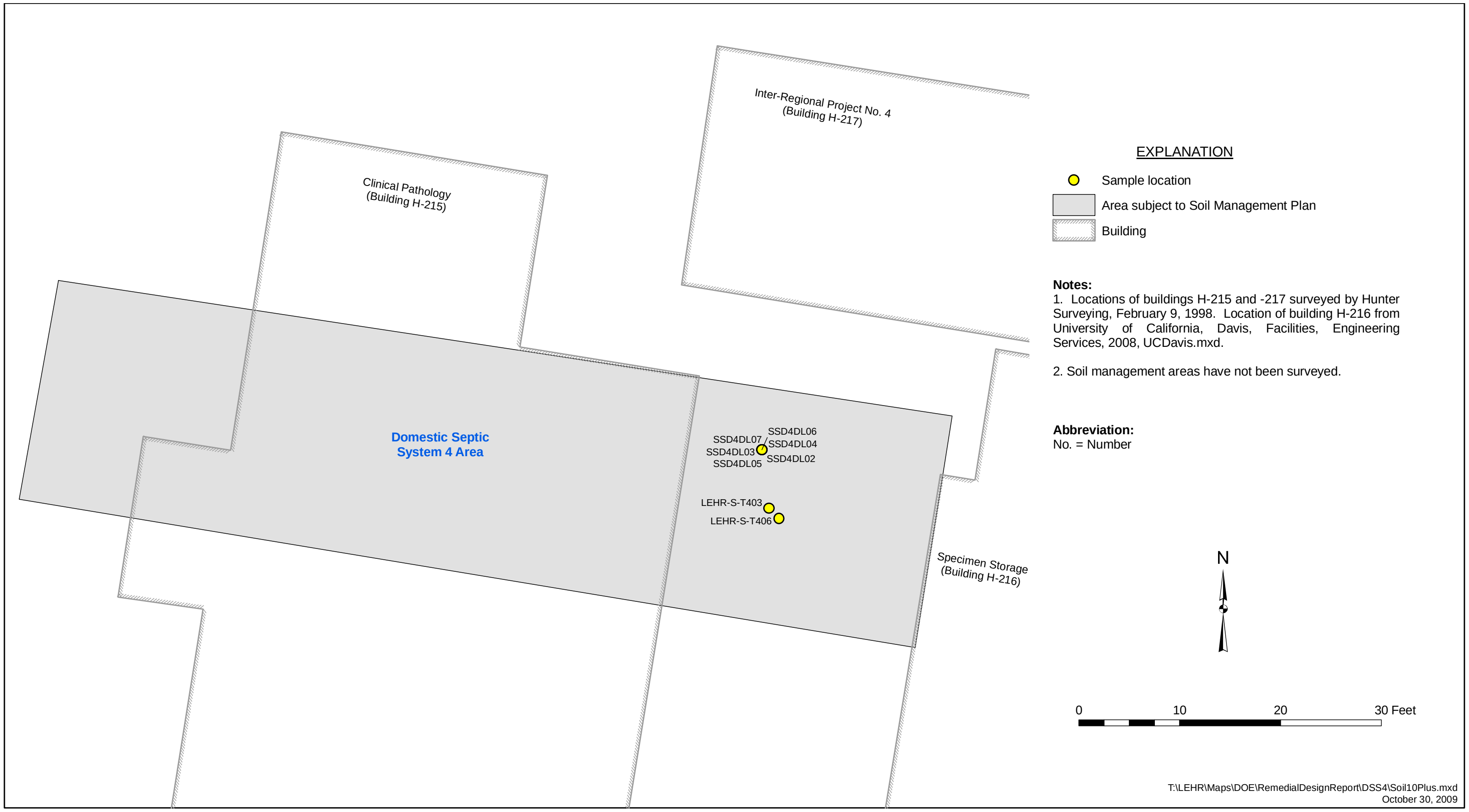
Attachment B Figure 2. Soil Sample Locations for the Domestic Septic System 3 Area (>4 to 10 Feet Below Ground Surface)

Attachment B Figure 3. Soil Sample Locations for the Domestic Septic System 3 Area (>10 to 40 Feet Below Ground Surface)

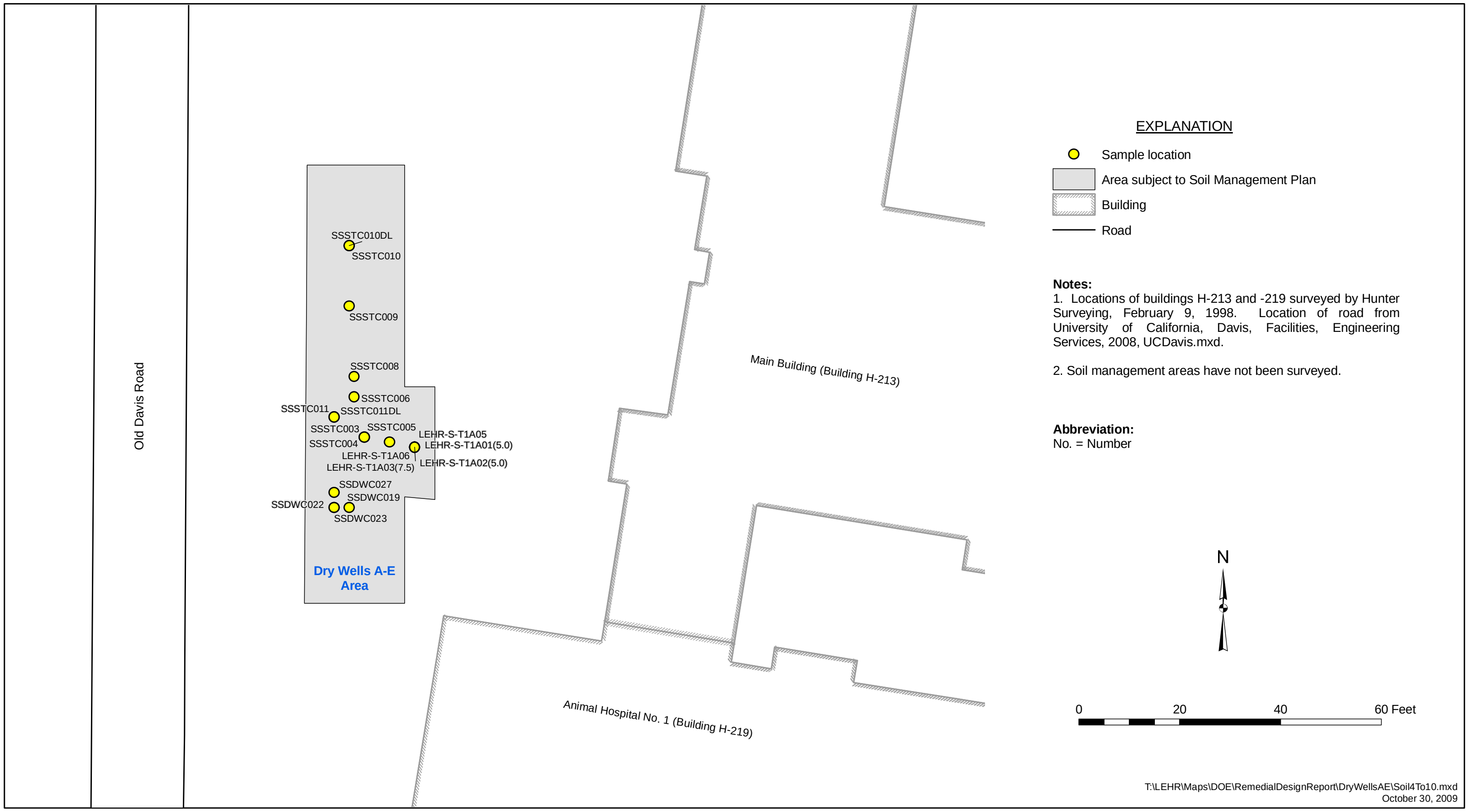


Attachment B Figure 4. Soil Sample Locations for the Domestic Septic System 4 Area (>4 to 10 Feet Below Ground Surface)

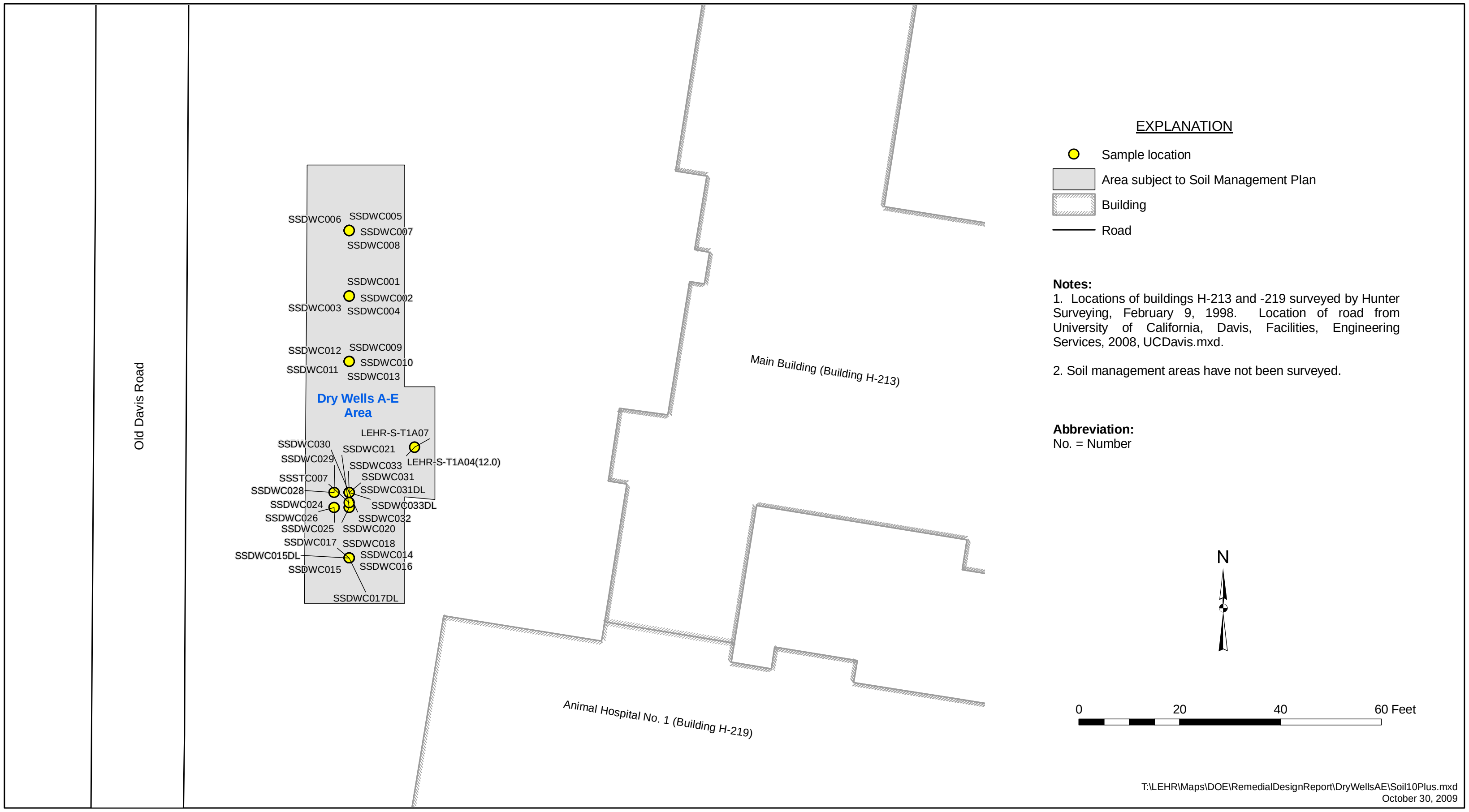
Note: No sample data exists for soil beneath Building H-215. Contamination similar in nature to that reflected by existing sample data near the building should be expected.



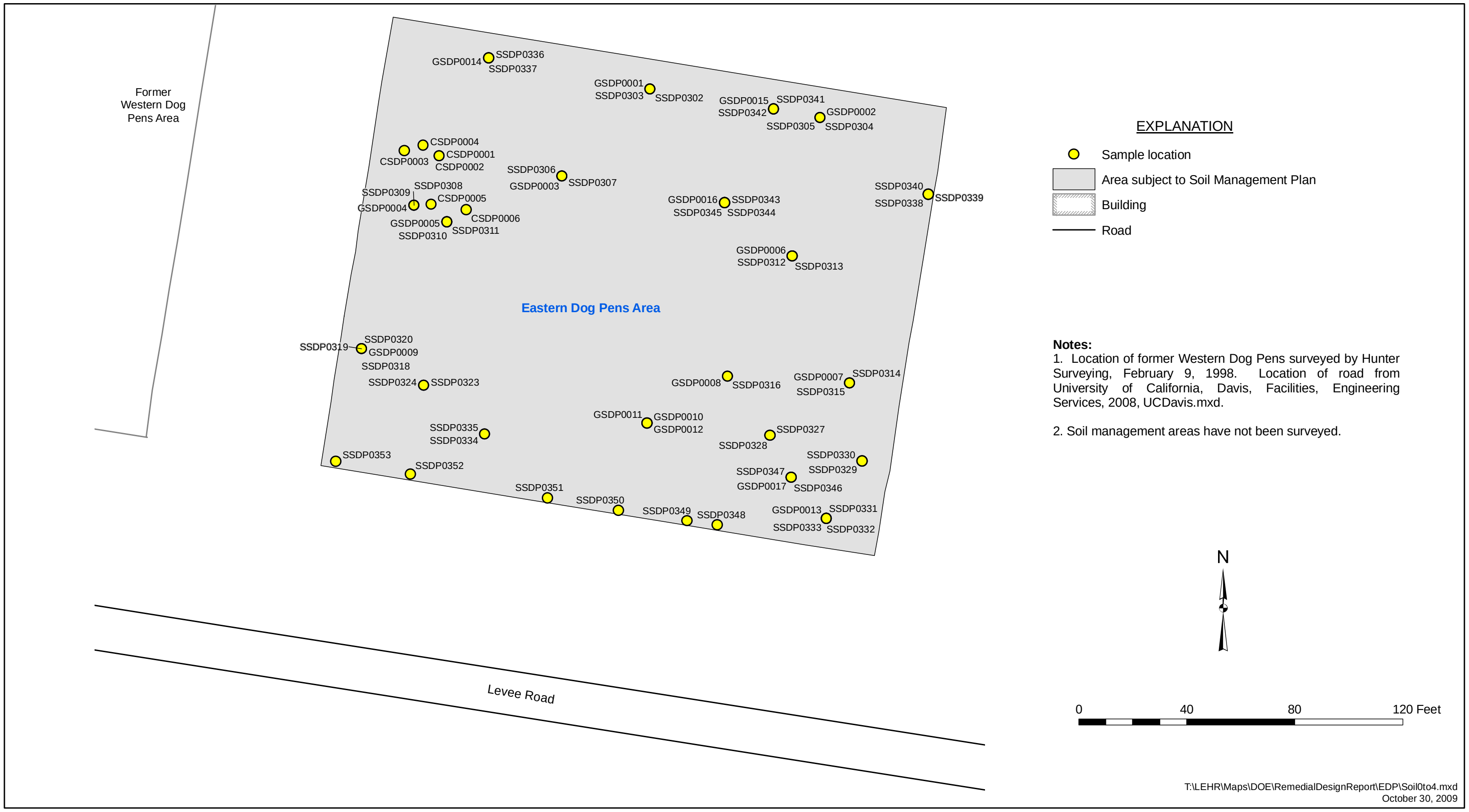
Attachment B Figure 5. Soil Sample Locations for the Domestic Septic System 4 Area (>10 to 37.8 Feet Below Ground Surface)



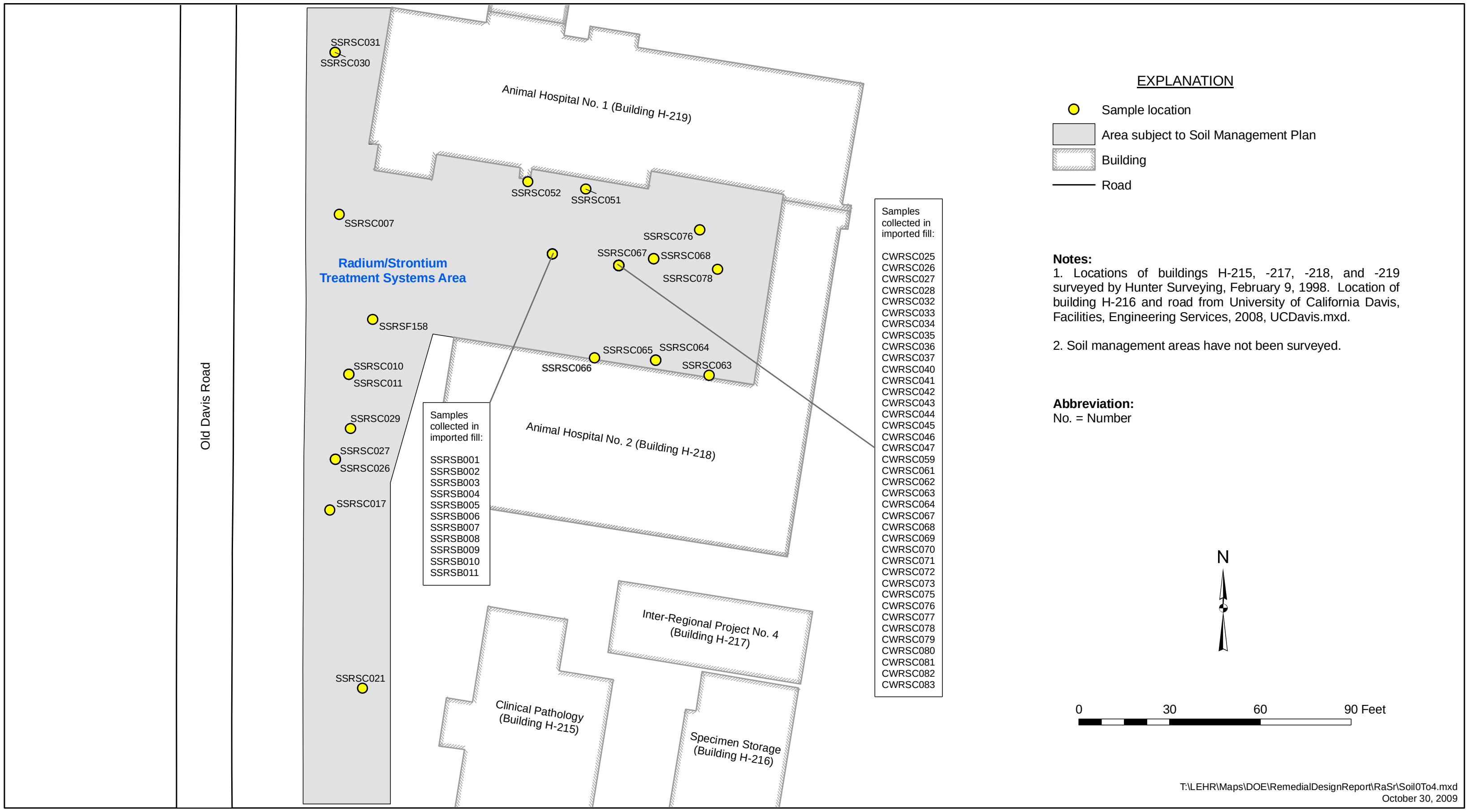
Attachment B Figure 6. Soil Sample Locations for the Dry Wells A-E Area (>4 to 10 Feet Below Ground Surface)



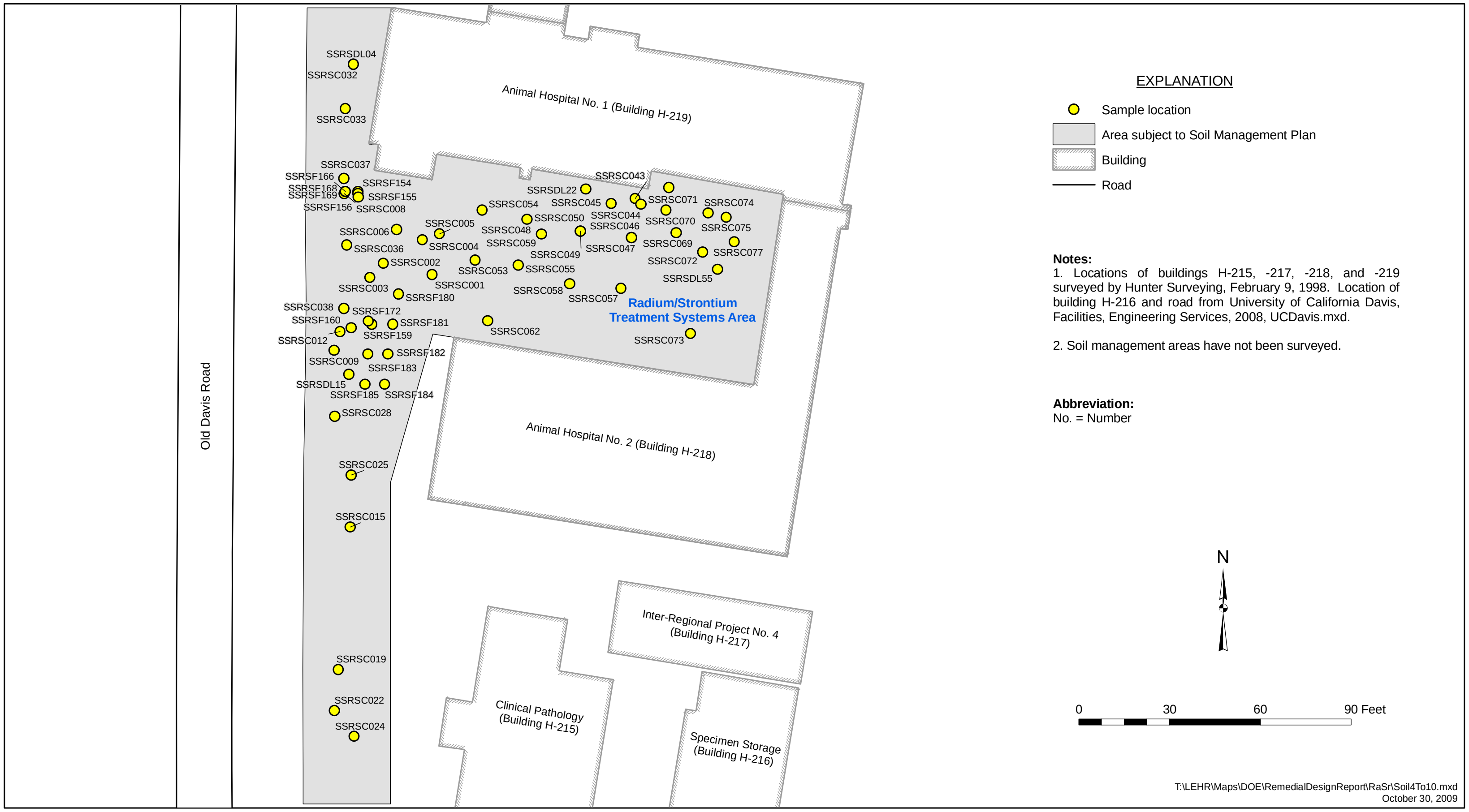
Attachment B Figure 7. Soil Sample Locations for the Dry Wells A-E Area (>10 to 40 Feet Below Ground Surface)



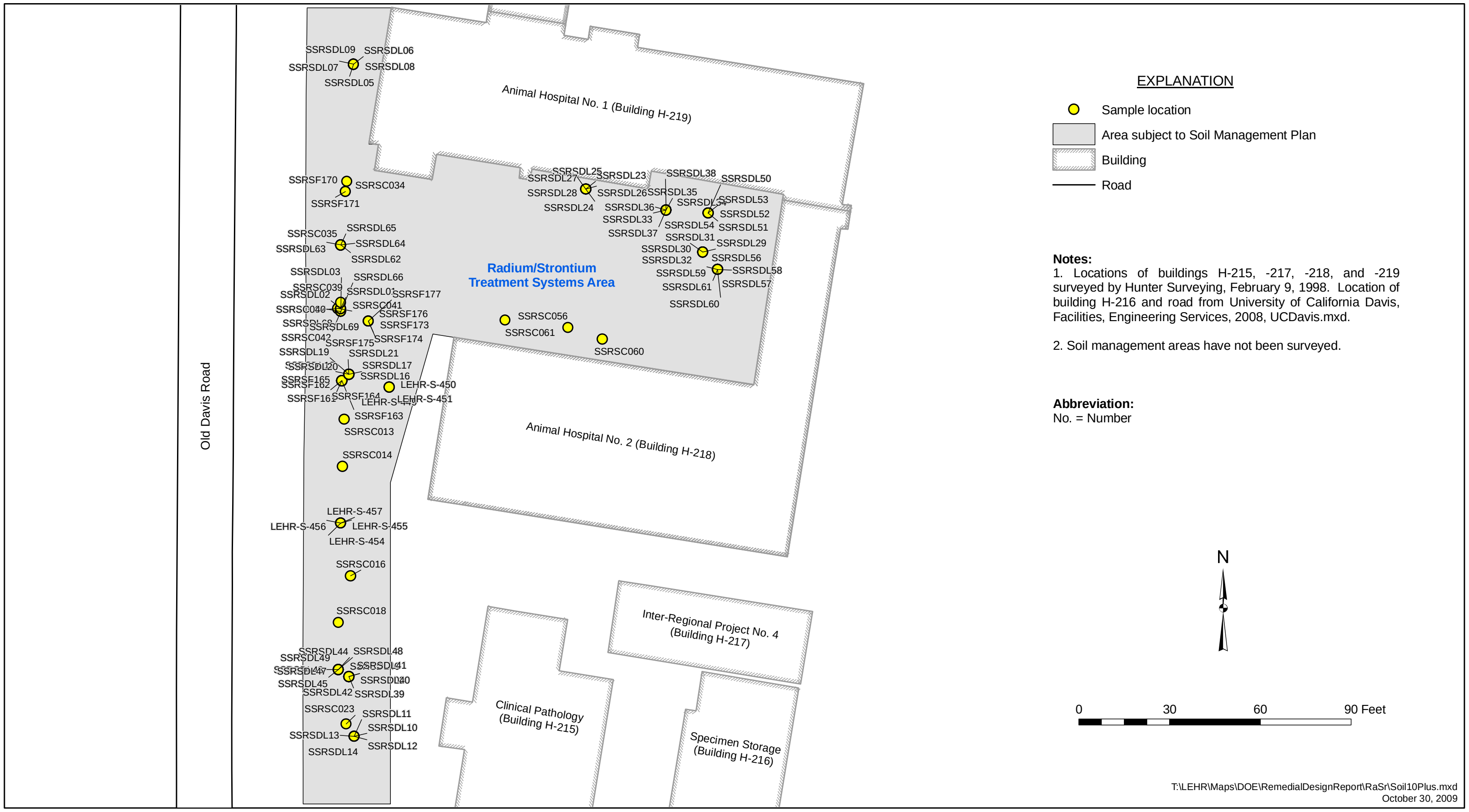
Attachment B Figure 8. Soil Sample Locations for the Eastern Dog Pens Area (0 to 4 Feet Below Ground Surface)



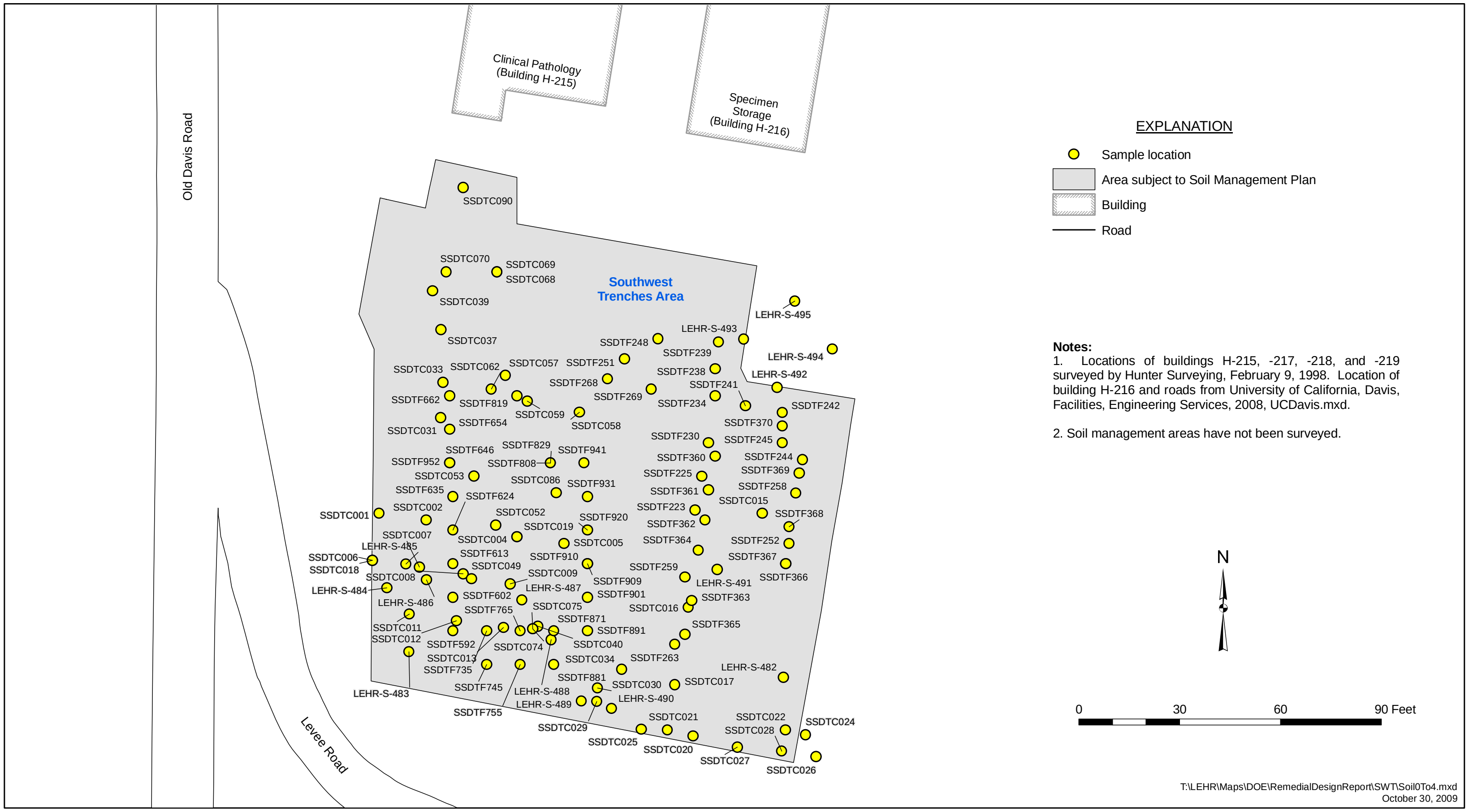
Attachment B Figure 9. Soil Sample Locations for the Radium/Strontium Treatment Systems Area (0 to 4 Feet Below Ground Surface)



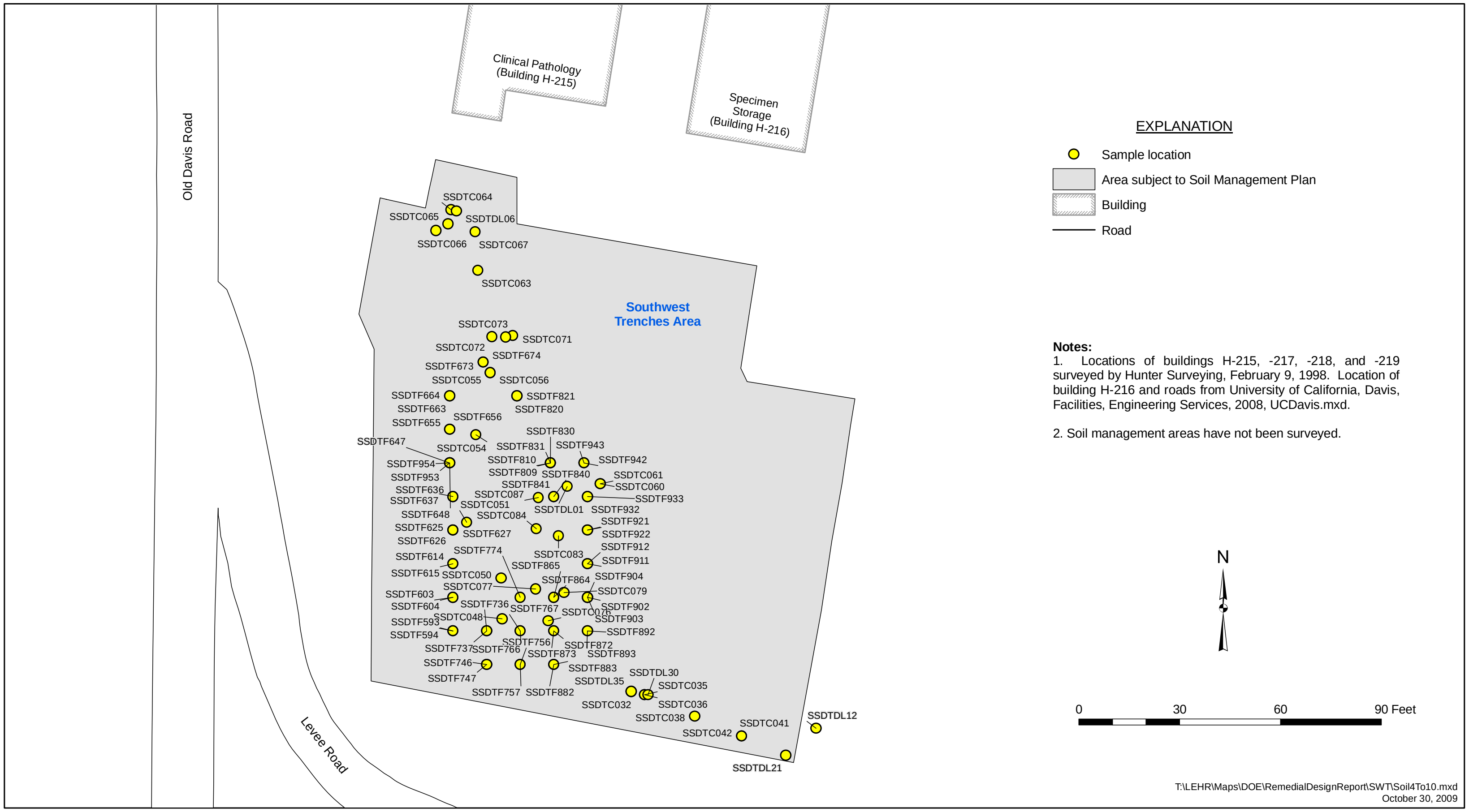
Attachment B Figure 10. Soil Sample Locations for the Radium/Strontium Treatment Systems Area (>4 to 10 Feet Below Ground Surface)



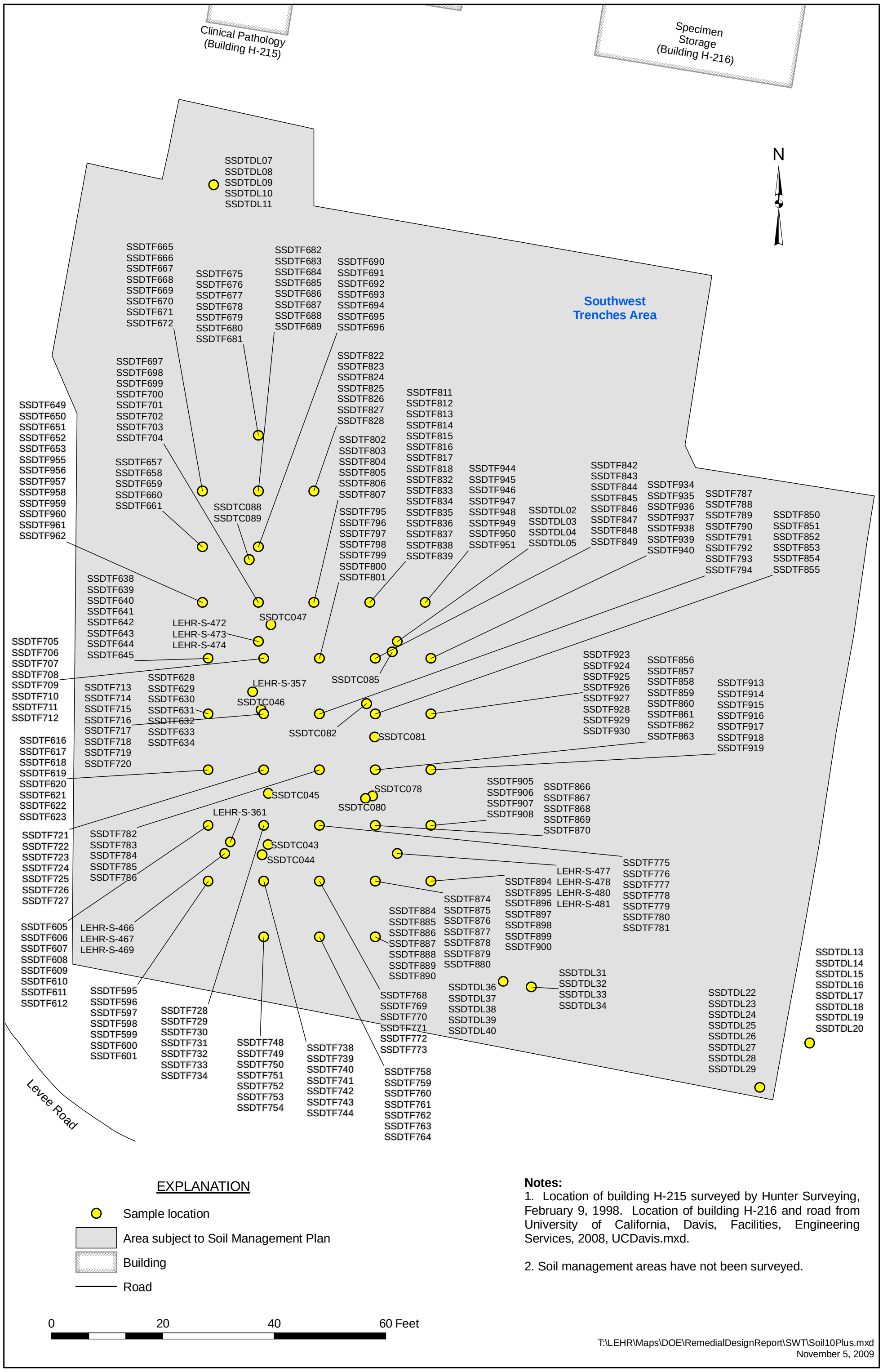
Attachment B Figure 11. Soil Sample Locations for the Radium/Strontium Treatment Systems Area (>10 to 47.5 Feet Below Ground Surface)



Attachment B Figure 12. Soil Sample Locations for the Southwest Trenches Area (0 to 4 Feet Below Ground Surface)



Attachment B Figure 13. Soil Sample Locations for the Southwest Trenches Area (>4 to 10 Feet Below Ground Surface)



Attachment B Figure 14. Soil Sample Locations for the Southwest Trenches Area (>10 to 44 Feet Below Ground Surface)

Attachment C

Analytical Results, Soil Samples Collected in DOE Areas (on CD-ROM)

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Attachment D

Soil Disturbance Permit

PERMIT APPLICATION FOR SOIL DISTURBANCE AT LEHR SUPERFUND SITE

This section to be completed by unit performing work.

Work requested by: ____

____

Work to be performed by:____

____

Schedule:____

____

Describe proposed work, or attach documents describing scope:______________________

____

____

____

____

____

Anticipated depth of soil disturbance:____

____

- ☐ Map indicating project location(s) and anticipated area(s) of soil disturbance is attached.
- ☐ List project plans submitted with application:______________________________

____

____

____

Requestor Signature:____

Unit:____

Name/Title:____

Date:____

PERMIT CONDITIONS

This section to be completed by EH&S Unit.

☐ Soil disturbed is in areas not subject to SMP for DOE areas. No SMP conditions apply. **STOP HERE.**

☐ Work to be performed in areas subject to SMP for DOE areas.

☐ Site inspection conducted (date)____ ____

☐ Possible to relocate work to avoid soil disturbance in area subject to SMP. Discussed with project requestor. Describe, and attach site map with alternate location(s): ____________ ____ ____ ____ ____ ______________________________

☐ Requestor agrees to relocate work to area not subject to the SMP. Attach new map showing new project location. **STOP HERE.**

☐ Project will disturb soil in area(s) subject to the SMP per survey maps and legal descriptions of DOE areas subject to land-use restrictions. The conditions checked below will be in effect:

- ☐ All project staff must be trained on aspects of the SMP relevant to their work.
- ☐ Soil disturbed at 0–10 feet below ground surface will be sampled for constituents in attached table. (attach Table A−1 and indicate sections applicable to area being disturbed.)
- ☐ Soil disturbed at 0–10 feet below ground surface contaminated above site background may not be reused on site without a risk assessment approved by DTSC and EPA. Soil with contaminant concentrations at or below background will be considered clean and may be reused on site.
- ☐ Soil disturbed at >10 feet below ground surface will be sampled for constituents determined by professional judgment to be potentially present in the soil in concentrations above site background (source: Attachment C of the SMP).
- ☐ Soil disturbed at >10 feet below ground surface will not be reused on site without a risk assessment approved by DTSC and EPA if it contains contaminant concentrations above the site background. Soil with contaminant concentrations below background values will be considered clean and may be reused on site.
- ☐ Non-soil waste (e.g., personal protective equipment) contaminated from contact with site soil must be characterized and managed according to its designation.
- ☐ The characterization of all waste is the responsibility of the requesting party.
- ☐ Results of any soil scan/sampling/characterization activities associated with this soil disturbance will be submitted to the EH&S Unit.
- ☐ Provide map of soil excavation, soil reuse locations, volumes of soil reused, and/or volumes of soil disposed of, and documentation of disposal.

  Oversight by an environmental professional is required on a/an [frequency]________________ ___ basis.
- ☐ Inspection by the EH&S Unit to be conducted on a/an [frequency] ____________________ ________________ basis.
- ☐ If unusual or unexpected conditions are discovered, such as discoloration or unexpected contamination, during this soil disturbance, the project requestor will immediately notify the

EH&S Unit. The EH&S Unit will coordinate the notification of DOE and the regulatory agencies concerning the unexpected conditions.

Environmental Professional Review. (List documents reviewed and comments on the project's compliance with the SMP; the ROD; and all applicable laws, regulations, and standards.)

____

____

____

____

____

____

Signature:____

____

Name/Title:____

________________________Date:________________________________

PERMIT APPROVAL

☐ Project Approved

☐ Project Denied (Explain rationale.)

____

____

____

____

____

____

EH&S Unit Representative Signature:____

____

Name/Title:____

________________________Date:________________________________

Comments on this package are noted below and retained in the file: ________________________

____

____

____

PERMIT CLOSE OUT

☐ Required Project Documents Received

☐ Missing Documents and Remedy/Date/Responsible Party

EH&S Unit Representative Signature:

Name/Title:

Date:

Appendix B

Memorandum of Agreement

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MEMORANDUM OF AGREEMENT BETWEEN THE UNITED STATES DEPARTMENT OF ENERGY AND THE REGENTS OF THE UNIVERSITY OF CALIFORNIA REGARDING THE INVESTIGATION, REMEDIATION, LONG-TERM SURVEILLANCE, MAINTENANCE, AND CONTINGENT REMEDIATION OF THE LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH AT THE UNIVERSITY OF CALIFORNIA, DAVIS

INTRODUCTION

Whereas, the United States Department of Energy ("DOE") and The Regents of the University of California ("the University") (referred to collectively as "the Parties") entered into Contract DE-AC03-76SF00472 ("the Contract") for the operation of the Laboratory for Energy-Related Health Research ("LEHR"); and

Whereas, the research at LEHR was initially performed under Project Agreement Nos. 4 and 6 of Contract No. AT(l1-1)-10, which was consolidated under Contract No. AT(04-3)-472 (June 29, 1965), which was thereafter redesignated Contract No. E(04-3)-472 by Contract Modification 32 (June 26, 1975), which was thereafter redesignated Contract EY-76-C-03-0472 by Contract Modification 43 (January 10, 1977), which was thereafter redesignated Contract DE-AM03-76SF00472 by Contract Modification No. A057 (April 18, 1979), and which was finally redesignated Contract DE-AC03-76SF00472 by Contract Modification No. A095 (August 9, 1984); and

Whereas, the University is the owner of the land upon which the LEHR Facility is located and gave DOE the right to occupy the land and to build improvements thereon in an Occupancy Agreement dated June 29, 1965 ("Occupancy Agreement"); and

Whereas, the Parties entered into a Memorandum of Agreement ("MOA") dated August 29, 1988 (amended on September 29, 1989), which outlined the University's use of the buildings, structures, facilities, and other improvements owned by DOE ("the DOE Improvements") at the LEHR Facility under the Occupancy Agreement; and

Whereas, the Parties entered into an MOA for environmental restoration and decontamination dated March 13, 1990 (amended on February 17, 1993, and again on November 30, 1993, and again on June 18, 1997, referred to collectively as the "Prior MOA"), which outlined the roles and responsibilities of the Parties regarding the investigation and remediation of the LEHR Facility and other areas; and

Whereas, DOE has investigated the LEHR Facility, the University Disposal Areas, University-Affected Groundwater and DOE-Affected Groundwater (as defined in Article I.C), and portions of the Adjacent Areas, and has begun remediating portions of the LEHR Facility; and

Whereas, the University has investigated the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, DOE-Affected Groundwater, and portions of the Adjacent Areas, and has begun remediating portions of the University Disposal Areas and University-Affected Groundwater and is continuing to investigate some of these areas; and

Whereas, the Parties wish to replace the Prior MOA with a new MOA ("Agreement") that establishes a new agreement between the Parties regarding the investigation, remediation, long-term surveillance and maintenance, and contingent remediation ("IR & LTSMCR") of the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, and DOE-Affected Groundwater, as well as future LEHR Facility redevelopment by the University.

Now, therefore, the Parties agree as follows:

ARTICLE I − PURPOSE AND SCOPE

A. The purpose of this Agreement is to allocate between the Parties in an equitable and efficient manner activities necessary to perform future IR & LTSMCR consistent with each Party's Record of Decision ("ROD") for the LEHR Facility, the University Disposal

Areas, University-Affected Groundwater, and DOE-Affected Groundwater, and to provide access to DOE to complete IR & LTSMCR activities as required pursuant to the DOE ROD, and to provide the means to integrate DOE's IR & LTSMCR activities with future University of California, Davis ("UC Davis"), remediation, site maintenance, and redevelopment projects.

B. The University and DOE intend this Agreement to be a settlement of their responsibilities and liabilities to each other for the implementation of the IR & LTSMCR of the LEHR Facility. Neither the fact of execution of this Agreement nor any of the terms of this Agreement is or shall be construed as an admission of liability or fact by the University or DOE.

C. The following definitions apply in this Agreement:

1. The term "LEHR Facility" means the following areas within the designated boundary shown in Figure 1: Maintenance Shop (H-212); Main Building (H-213); the location of the former Imhoff Building (H-214); Reproductive Biology Laboratory (H-215); Specimen Storage (H-216); Inter-regional Project No. 4 (H-217); Animal Hospital No. 2 (H-218); Animal Hospital No. 1 (H-219); Co-60 Building (H-229); Occupational and Environmental Medicine Building (H-289); Co-60 Annex (H-290); Geriatrics Building No. 1 (H-292); Geriatrics Building No. 2 (H-293); Cellular Biology Laboratory (H-294); Small Animal Housing (H-296); Toxic Pollutant Health Research Laboratory (H-299); Storage Space (H-300); the cobalt-60 irradiation field; the southwest trenches; the strontium-90 and radium-226 leach fields and the radium-226 waste tanks; the dog pens and associated soils and gravel; the seven septic tanks; the Imhoff storage tanks; and the DOE disposal box.

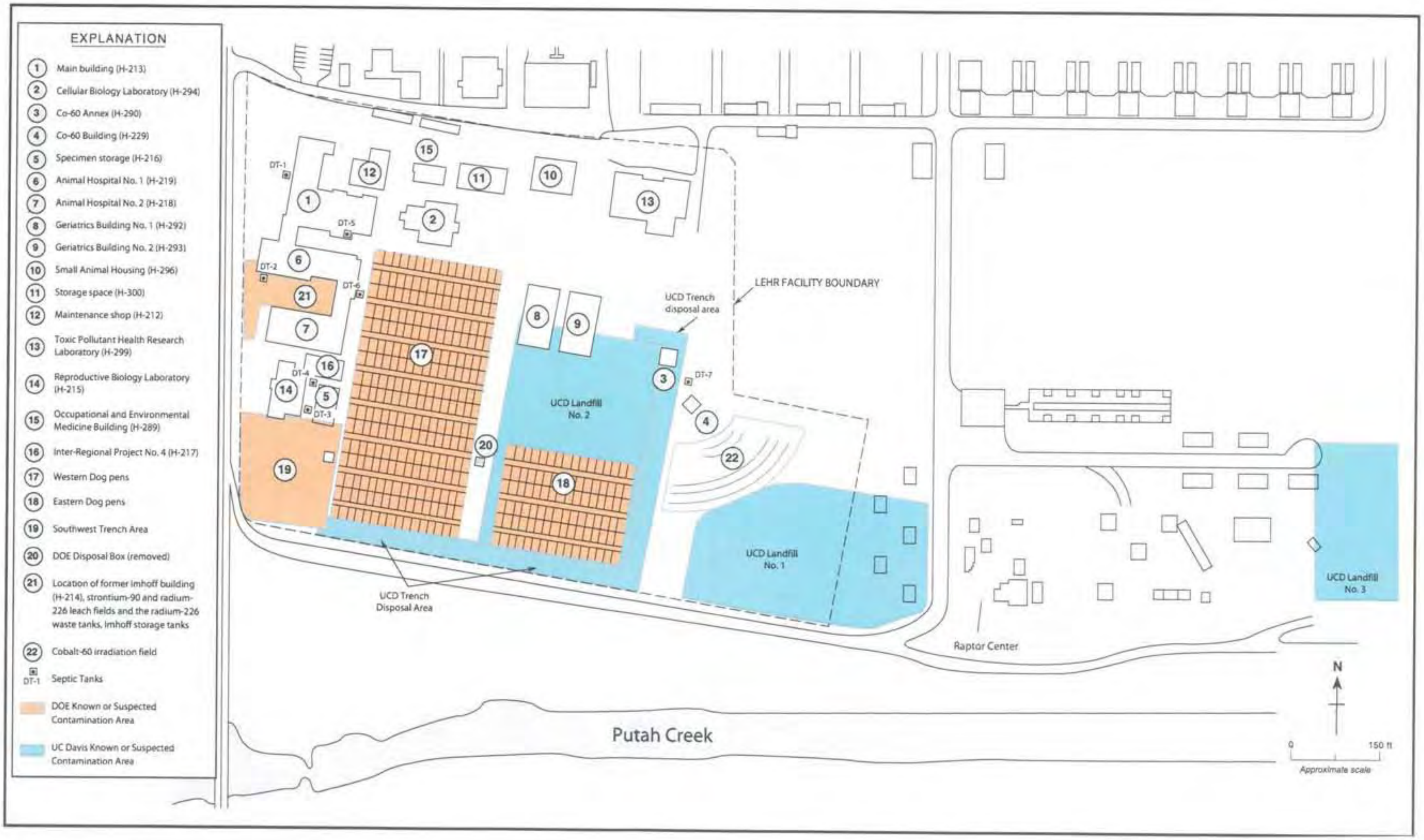

Figure 1. LEHR Facility/Old Campus Landfill, UC Davis, California

2. The term "University Disposal Areas" means the following areas shown in Figure 1: University landfill cells beneath the LEHR Facility; Landfills 1, 2 (exclusive of dog pens), and 3; the 49 waste burial holes; and the UC Davis eastern and southern disposal trenches. The Parties agree that the areas specifically listed above as "University Disposal Areas" are not part of the LEHR Facility for purposes of this Agreement even though some of them are partially or entirely within or beneath the designated boundary shown in Figure 1.

3. The term "DOE-Affected Groundwater" means groundwater containing contaminants released from the LEHR Facility as a result of DOE-funded activities. "DOE-Affected Groundwater" excludes groundwater impacted by releases from the University Disposal Areas regardless of whether it is determined that the University Disposal Areas contain waste from the LEHR Facility.

4. The Term "University-Affected Groundwater" means groundwater containing contaminants released from the University Disposal Areas.

5. The term "Adjacent Areas" means the portions of the UC Davis campus and adjacent areas, including, but not limited to, areas shown in Figure 1, other than the LEHR Facility and University Disposal Areas.

6. The term "Contingent Remediation" means an undetermined remedial action implemented by DOE if residual soil contaminants in a DOE area impact groundwater in the future. The response action, if required, will be determined in the future based on available technology, site conditions, and acceptance by the regulatory agencies in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA") process.

7. The term “Soils Management Plan” (“SMP”) means the development of a plan describing the nature and extent of contamination remaining on the LEHR Facility. The SMP will describe the following elements: (1) the distribution of soil contaminants in the LEHR Facility, (2) controls and procedures to be used to reduce the potential human risks from exposure associated with contaminated soil and reduce the risk of potential environmental harm, and (3) procedures for the management and disposal of waste soils generated during the maintenance, repair, and construction activities or other activities that may disturb the subsurface soils.

8. The term “Long-Term Surveillance and Maintenance” refers to the mechanisms necessary to ensure both short- and long-term protection of the public and the environment after initial cleanups at facilities in the DOE complex have reached closure. These mechanisms include physical and institutional controls, information management, environmental monitoring, and risk assessment. The DOE Office of Legacy Management, established in 2003, focuses on the long-term performance of remedies and the effects of residual contamination at sites.

ARTICLE II – COOPERATION AND COORDINATION

A. Dispute Resolution

If a dispute arises under this Agreement, the Parties shall use the dispute resolution procedure set forth below.

1. DOE shall give written notice of any decision to invoke the dispute resolution procedure to the Director of Environmental Health & Safety (“EH&S”) at UC Davis, Davis, California 95616. The University shall give written notice of any decision to invoke the dispute resolution procedure to the Team Leader of the Environment Team, DOE Office of Legacy Management, 2597 B ¾ Road, Grand

Junction, Colorado 81503. Either Party may change the designated recipient of the written notice by providing written notification to the other Party.

2. The UC Davis Director of EH&S and the DOE Team Leader of the Environment Team shall then confer in an effort to resolve the dispute. If the Parties cannot resolve the dispute within fifteen (15) days, the dispute shall be raised to the Director of the Office of Site Operations, DOE Office of Legacy Management, and the Associate Vice Chancellor of Safety Services of UC Davis for resolution.

3. The DOE Director of the Office of Site Operations and UC Davis Associate Vice Chancellor of Safety Services shall confer and, within thirty (30) days of receiving the dispute, issue a joint decision resolving the dispute. If the Parties cannot resolve the dispute, the dispute shall be raised to the Deputy Director of the DOE Office of Legacy Management and the UC Davis Vice Chancellor of Administration for resolution.

4. The DOE Deputy Director of the Office of Legacy Management and UC Davis Vice Chancellor of Administration shall confer and, within thirty (30) days of receiving the dispute, issue a joint decision resolving the dispute or referring the matter to mediation. From the date of the joint decision referenced in the previous sentence, the Parties shall select a mediator within fifteen (15) days, exchange mediation statements within (30) days, and set the matter for mediation conference within forty-five (45) days, or later at the request of the mediator.

5. If the Parties are unable to resolve the dispute after the mediation conference referenced in the previous paragraph, either Party may seek any appropriate relief available at law or in equity. Except as otherwise provided in this Agreement, the Parties reserve all of their respective rights under applicable law, this Agreement, the Occupancy Agreement, and the Contract.

B. Health and Safety Oversight

DOE and the University shall oversee and manage their respective workers, contractors, and subcontractors to ensure that they comply with applicable federal and state health and safety standards.

C. Meetings

DOE, the University, and their respective contractors shall meet as frequently as necessary to effectively coordinate and implement their respective activities under this Agreement.

D. Contacts with the Public

DOE will coordinate with UC Davis in the planning and execution of their public involvement activities relating to the IR & LTSMCR of the LEHR Facility and DOE-Affected Groundwater. If the Parties have a dispute regarding contacts with the public, the Parties shall use their best efforts to resolve the dispute according to the procedures set out in Section II.A of this Agreement. The Parties shall also use best efforts to provide each other with reasonable prior notice of the public release of information and documents.

E. Support and Coordination of Investigative and Remedial Activities

1. The University and DOE shall cooperate to ensure that, to the extent reasonably practicable, the IR & LTSMCR, remediation strategies, and site development by both Parties are consistent and cost-effective—provided, however, that the duty to cooperate shall not require either Party to unreasonably delay its activities under this Agreement.

2. The University and DOE shall coordinate with each other, to the extent reasonably practicable, all communications with federal, state, and local regulatory agencies, including presentations and reports of findings, monitoring

results, and recommendations concerning their respective IR & LTSMCR activities. The Parties realize that DOE and the University have submitted and will continue to submit documents relating to the activities each is obligated to perform under this Agreement and that such documents contain and may contain, among other things, proposals on remediation strategies, methodologies, cleanup levels, and IR & LTSMCR. The Parties acknowledge that each has the same rights as any member of the public to comment on submissions made by the other Party. However, each Party agrees that it shall provide any comments it may have on the other Party's submissions first to the Party making the submission in order to promote cooperation between the Parties and to ensure that any issues regarding IR & LTSMCR, and other topics, are resolved consistently, quickly, and efficiently.

3. DOE agrees to conduct its activities in such a manner as to minimize, to the extent reasonably practicable, disruption of the University's research. Any communications from DOE to the University's research staff and campus services shall be coordinated through the DOE and UC Davis Project Managers.

F. Providing Information and Access

1. Each Party agrees to provide the other Party with all available non-privileged information on its site activities, including, but not limited to, data, primary documents (e.g., remedial investigation reports, feasibility studies), schedules, cleanup standards, future plans, and methodologies.

2. The University agrees to use reasonable efforts to provide DOE (and any persons designated by DOE) with access to the portions of the LEHR Facility or other parts of the UC Davis campus if necessary for DOE to conduct the activities DOE is required to perform under the DOE ROD. DOE shall limit its requests

concerning such areas to areas that it must access to conduct the activities and shall provide UC Davis with reasonable advance notice of when, where, and why it needs access to a particular area.

3. The University agrees to record a Land Use Covenant restricting the future use of the University-owned property above the DOE areas as described in the DOE ROD and so that DOE (and any person designated by DOE) will have access to the former DOE areas in order that DOE may perform any long-term surveillance and maintenance or contingent remediation as shown on Figure 2. In order to implement and maintain the Land Use Covenant and other activities the Parties have agreed to, the University will sustain certain costs. In order to compensate the University for those costs, subject to Article VII B DOE agrees to provide a Grant to the University to cover costs associated with the Land Use Covenant and other agreed-to tasks until the Land Use Covenant is entirely terminated for the DOE areas. The Grant applies to the DOE Areas for the LEHR site. The work includes, but is not limited to:

   (a) Recording the Land Use Covenant with the California Department of Toxic Substances Control.

   (b) Developing and maintaining internal policies and procedures to ensure that land use restrictions are maintained.

   (c) Visiting sites to ensure that land use restrictions are maintained.

   (d) Developing and providing annual training for campus stakeholders affected by the restrictions.

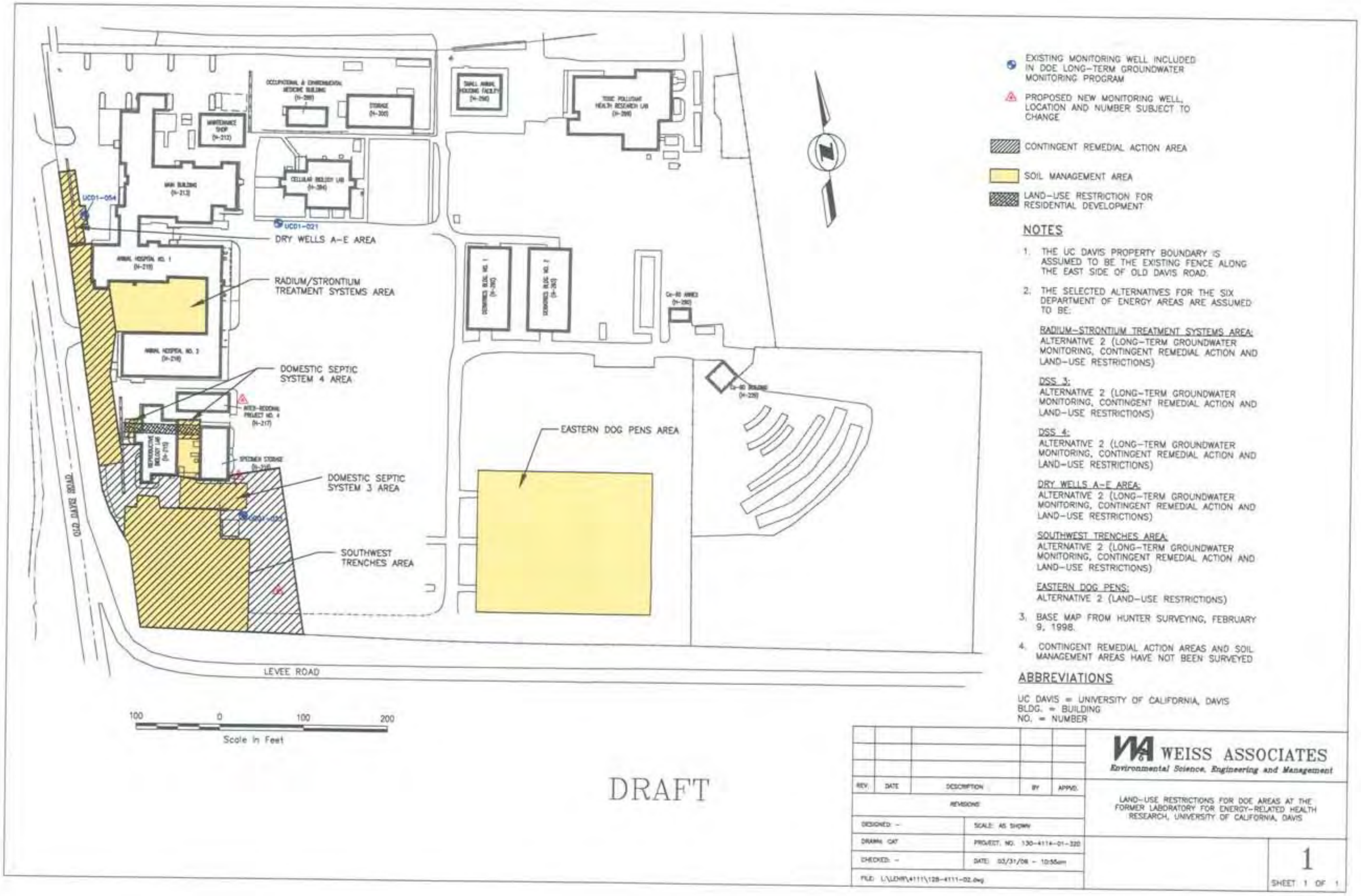

Figure 2. Land Use Restrictions for DOE Areas at the Former Laboratory for Energy-Related Health Research, UC Davis, California

(e) Providing for activities that require the implementation of the DOE Areas SMP.

(f) Controlling weeds and performing miscellaneous maintenance activities, as requested by DOE.

(g) Conducting DOE groundwater and surface water monitoring and reporting, as requested by DOE.

(h) Providing other services as agreed to by DOE and UC Davis.

Such Grant shall be in place within sixty (60) days of the effective date of this Agreement and shall be renewed annually for as long as the Department of Toxic and Substance Control (DTSC) Land Use Covenant remains in place. The University shall have no obligation to perform the services identified in subparagraphs (b) through (h), above, during any period for which DOE has not provided a Grant that covers the University's full costs for providing such services. In accordance with the provisions of CERCLA, DOE shall conduct Five-Year Reviews to ensure the protectiveness of the remedy. Following each Five-Year Review, DOE shall consult with the United States Environmental Protection Agency ("EPA"), DTSC, and the Regional Water Quality Control Board, or the successors to these agencies, to determine whether it is necessary for the Land Use Covenant to remain in effect or whether the Land Use Covenant can be terminated entirely or amended to delete specific DOE waste units from the land use restrictions.

4. DOE will direct the contractors it selects to conduct DOE activities to keep the University apprised of their activities and to coordinate in advance with the University regarding any activities that might interfere with the University's use of those DOE

Improvements that have been transferred to the University pursuant to Article VI of this Agreement.

5. DOE shall notify the University through the UC Davis Project Manager of any of its activities that might implicate the permit requirements of the Resource Conservation and Recovery Act ("RCRA") regarding the LEHR Facility. DOE shall also provide any other information related to its activities that could impact UC Davis's National Pollutant Discharge Elimination System ("NPDES") Permits (i.e., the permit for the main campus waste water treatment plant and the campus's general storm water permit) as they apply to the LEHR Facility. The University is responsible for obtaining and complying with the NPDES Permits. The University is responsible for obtaining and complying with any permits that are required in connection with the activities set forth in Article III. DOE is responsible for obtaining and complying with any NPDES, RCRA, or other permits that are required in connection with the activities set forth in Article IV.

6. DOE and the University shall each pay, in accordance with state and federal law, those reasonable and necessary costs incurred by such state regulatory agencies related to the activities that each Party is obligated to perform under this Agreement or under other agreements with, or directives from, such regulatory agencies. The Parties shall cooperate to ensure that they establish reasonable and efficient procedures that will allow the state regulatory agencies to allocate their costs.

ARTICLE III − RESPONSIBILITIES OF THE UNIVERSITY

The University agrees to undertake at its own expense the following activities:

A. Environmental Restoration

1. The University agrees to conduct required response actions inclusive of the remedial investigation, feasibility study, removal, remedial action, reports, sampling, analyses, and any other investigative and remedial activities required by federal and state regulatory agencies involving the University Disposal Areas and University-Affected Groundwater.

2. The University agrees to perform groundwater monitoring and reporting for DOE-Affected Groundwater until ninety (90) days after the signature of both Parties to this Agreement. The University agrees to include an analysis of DOE-Affected Groundwater in the University Feasibility Study and ROD. The University shall have no obligation to perform, or responsibility for, any interim action or response action that federal and state regulatory agencies may require for DOE-Affected Groundwater by inclusion of an analysis or discussion of DOE-Affected Groundwater in the University Feasibility Study or ROD.

3. Subject to the provisions of Sections IV.A and V.C of this Agreement, the University agrees to conduct any investigative or remedial work that federal or state agencies may require for sources of contaminants in the Adjacent Areas.

B. Removal of Wastes and Samples

1. Except as otherwise provided for in Section IV.A of this Agreement, the handling, storage, and disposal of all wastes (radioactive, hazardous, mixed, and solid) generated by the University's activities under this Agreement, and of all samples and other

research materials of the University currently stored in the LEHR Facility, are the sole responsibility of the University.

C. In the event that the University plans a project beyond repair, maintenance, and minor construction that may trigger the SMP, the University will notify DOE at least ninety (90) days prior to the commencement of field activities.

ARTICLE IV − RESPONSIBILITIES OF DOE

DOE agrees to undertake at its own expense the following activities:

A. Environmental Restoration

1. DOE shall complete the remedial investigations, feasibility studies, removal, remedial action, reports, sampling, analyses, and any other investigative, remedial, and IR & LTSMCR activities required by federal and state regulatory agencies for the LEHR Facility, to the satisfaction of the regulatory agencies—provided, however, that any decontamination or decommissioning of the DOE Improvements has been or shall be performed under the Atomic Energy Act of 1954 and applicable DOE Orders.

2. Ninety (90) days after signature by both Parties to this Agreement, DOE will assume full responsibility for groundwater monitoring and reporting for DOE-Affected Groundwater. All post–University ROD actions required for DOE-Affected Groundwater shall be the sole responsibility of DOE. Any interim or removal actions required by federal and state regulators before EPA signs the University ROD shall be the sole responsibility of DOE.

3. DOE shall prepare an SMP describing the nature and extent of contamination remaining in DOE areas to address actions that may be required to protect public health and the environment relevant to residual DOE contamination left on site. A plan will be

prepared with the DOE Remedial Action Work Plan and will address the need for any evaluation, risk assessment, sampling, characterization, containment, treatment, removal, disposal, or other action that may be required for future remediation, use, operations, or maintenance activities anticipated to be undertaken by the University. DOE is solely responsible for the costs of implementing the SMP and any additional administrative, engineering, design, construction, or operations and maintenance costs incurred by the University in the course of its projects that arise due to the presence of DOE contamination left at the site. The Parties may agree to the implementation of the SMP by the University on behalf of DOE. If the University plans a project at the site that will necessitate the implementation of the SMP, and that may require additional evaluation, the University will request DOE's input on the management options.

4. DOE shall continue to perform storm water monitoring, as required, at Lift Station-1. This storm water monitoring shall not include any monitoring required as a result of University operations or releases.

5. DOE agrees to prepare any reports, assessments, or other documents that may be required by federal or state regulatory agencies relating to its IR & LTSMCR of the LEHR Facility. Such reports and assessments may include, but are not limited to, risk assessments, ecological assessments, and assessments concerning release limits on residual radionuclides in soils.

6. The handling, storage, and disposal of all wastes (radioactive, hazardous, mixed, and solid) generated by DOE's activities under this Agreement are the sole responsibility of DOE. For purposes of this Agreement, the term "wastes" shall not include the following: (1) research materials, if any, that the University failed to identify as having

been used for DOE research under the Contract as required by the Prior MOA and Paragraph 1 of Section III.B of this Agreement, or (2) contaminated media such as soil, structures, buildings, debris, surface water, or groundwater that remain *in situ* once DOE has completed its activities under the DOE ROD to the satisfaction of the regulatory agencies unless such contaminated media are required to be removed or managed to comply with an SMP, or as part of contingent remediation determined to be necessary in the future. No waste will be disposed of, or otherwise remain, on University property without the express written permission of the University—provided, however, that DOE shall have no obligation to remove any contaminated media that remain *in situ* once DOE has completed its activities under the DOE ROD to the satisfaction of the regulatory agencies. The University agrees that permission to dispose of wastes at the LEHR Facility will not be unreasonably withheld. DOE shall be responsible for filing annual reports with the State of California for the management of hazardous and radioactive mixed wastes generated by or associated with DOE's activities as required under applicable laws and regulations.

ARTICLE V − COVENANTS NOT TO SUE

A. Covenants Not to Sue for Past Costs

Each Party covenants that it shall not sue or otherwise seek recovery or reimbursement of any kind from the other Party, or its employees, contractors, representatives, or agents, for costs it incurred after September 30, 1989, through and including the effective date of this Agreement, in investigating or remediating the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, DOE-Affected Groundwater, and Adjacent Areas. For purposes of this Agreement, such costs are referred to herein as "past costs" and consist of sums a Party paid or became obligated to pay during the period set forth above for investigation or remediation of the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, DOE-Affected Groundwater, and Adjacent Areas; for regulatory oversight costs; for defense or attorneys fees related to the investigation and remedial work; and for compliance with the orders or mandates of agencies or courts related to the investigation and remedial work.

B. <u>Covenants Not to Sue for Future Costs</u>

Except as specifically provided below in Section V.C of this Agreement, each Party covenants that it shall not sue or otherwise seek relief of any kind from the other Party, or its employees, contractors, representatives, or agents, for costs incurred after the effective date of this Agreement, arising from the obligations each Party has assumed under this Agreement. For purposes of this Agreement, such costs are referred to as “future costs” and consist of, but are not limited to, sums for investigation, remediation, or IR & LTSMCR of the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, DOE-Affected Groundwater, and Adjacent Areas; for compliance with this Agreement; for regulatory costs; for defense or attorneys fees related to the investigation and remedial work; and for compliance with the orders or mandates of agencies or courts related to the investigation, remediation, or IR & LTSMCR work. Except as specifically provided below in Section V.C of this Agreement, these covenants not to sue apply to all claims involving the investigation, remediation, or IR & LTSMCR of the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, and DOE-Affected Groundwater; claims for investigation or remediation of the Adjacent Areas; claims for regulatory costs; and claims involving compliance with the orders or mandates of agencies or courts related to the investigation, remediation, and IR & LTSMCR work based on federal law, state law, the Contract, or the Occupancy Agreement.

C. <u>Exceptions to the Covenants Not to Sue</u>

The Parties agree that the covenants not to sue set forth in this Section V shall not apply in the following situations:

1. **Claims Seeking to Enforce this Agreement.** The covenants not to sue in this Section V shall not apply to claims by either Party to enforce the terms of this Agreement.

2. **Claims by a Regulatory Agency in Conflict with this Agreement.** The Parties acknowledge that one purpose of this Agreement is to allocate between the Parties responsibilities for certain activities related to the investigation, remediation, or IR & LTSMCR of the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, DOE-Affected Groundwater, and Adjacent Areas. Should a regulatory agency assert a claim against a Party involving an activity or area that is the responsibility of the other Party under this Agreement, the covenants not to sue set forth in this Section V shall not apply to the extent that the Party against which the agency asserted the claim may seek relief from the other Party requiring it to respond to the agency's claim and to reimburse the Party against which the agency asserted the claim for any costs it incurred in responding to the claim.

3. **Claims by Third Parties other than Regulatory Agencies.** Neither the covenants not to sue nor any other provision of this Agreement shall apply to claims by third parties other than regulatory agencies. With respect to third-party claims, the Parties reserve all of their respective rights under applicable law, this Agreement, the Occupancy Agreement, and the Contract.

ARTICLE VI – DOE IMPROVEMENTS AT THE LEHR

A. Transfer of Certain DOE Improvements to the University

1. Pursuant to Article VII of the Occupancy Agreement, DOE transferred ownership of the DOE Improvements or portions thereof (hereafter referred to as "former DOE Improvements or portions thereof") to the University. This transfer of ownership of the DOE Improvements or portions thereof did not and does not affect in any way DOE's decontamination and decommissioning obligations under the Occupancy Agreement, the Contract, or this Agreement.

2. DOE previously released the DOE Improvements and the University has been using these improvements for research and appropriate support work sponsored by entities other than DOE. The University shall be responsible for any contamination by hazardous substances, radioactivity, or ionizing radiation fields resulting from the University's use of these former DOE Improvements or portions thereof.

ARTICLE VII – MISCELLANEOUS PROVISIONS

A. Amendment

This Agreement may be amended at any time by mutual consent of the Parties. Any such amendments shall be in writing, shall be explicitly identified as an Amendment to this Agreement, and shall be signed by both Parties.

B. Anti-Deficiency Act

No provision of this Agreement shall be interpreted as or constitute a commitment or requirement that DOE shall obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. § 1341. Payments by DOE are subject to the availability of appropriated funds. Payments by the University are subject to the availability of designated funds. The Parties agree that, during the period in which this Agreement remains in effect, each will be diligent in seeking appropriation or designation of funds for the purpose of performing its respective obligations under this Agreement.

C. Entire Agreement

This Agreement contains the entire agreement between the Parties with respect to the IR & LTSMCR of the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, DOE-Affected Groundwater, and Adjacent Areas, and with respect to the University's ownership of, and DOE access to, the DOE Improvements at the LEHR Facility. It supersedes all prior understandings, negotiations, oral agreements, or written agreements between the Parties including, but not limited to, the Prior MOA and Article XIV ("CONTINGENCIES - LITIGATION AND CLAIMS") of Contract EY-76-C-03-0472 as to the investigation and remediation of the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, and DOE-Affected Groundwater—provided, however, that this Agreement does not supersede the Contract or the Occupancy Agreement except as to their application to the investigation and remediation of the LEHR Facility, the University Disposal Areas, University-Affected Groundwater, DOE-Affected Groundwater, Adjacent Areas, and DOE access to the DOE Improvements at the LEHR Facility prior to the termination of the Occupancy Agreement.

D. Effective Date

The effective date of this Agreement is the date of the last signature.

E. No Third-Party Beneficiaries

This Agreement is solely for the benefit of the University and DOE, and shall create no rights in favor of, and may not be enforced by, any other person or entity.

F. Successors and Assigns

This Agreement shall bind and inure to the benefit of the Parties and their respective successors and assigns.

G. Governing Law

This Agreement shall be governed by and construed in accordance with the laws of the State of California and the United States.

H. Waiver of Provisions

No waiver of any of the provisions of this Agreement shall be deemed or shall constitute a waiver of any other provision, whether or not similar, nor shall any waiver constitute a continuing waiver. No waiver shall be binding unless executed in writing by the Party making the waiver.

I. Separability

If any term, covenant, condition, or provision of this Agreement is held by a court of competent jurisdiction to be invalid, void, or unenforceable, the remainder of the provisions shall remain in full force and effect and shall in no way be affected, impaired, or invalidated.

J. Headings

The subject headings used in this Agreement are for convenience only and shall not be deemed to affect the meaning or construction of any of the terms of this Agreement.

K. Counterparts

This Agreement may be executed in counterparts, each of which shall be deemed an original, and when taken together shall constitute an integrated agreement.

United States Department of Energy
~~Deputy~~ Director, Office of Legacy Management

David W. Geiser

Date: June 23, 2009

The Regents of the University
of California

STAN NOSEK, VICE CHANCELLOR-ADMINISTRATION

Date: JULY 8, 2009

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Appendix C

Travel Time Estimates for Constituents of Concern

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Table C–1. Estimated Contaminant Migration Travel Time from DOE Areas to Monitoring Wells

DOE Area	Monitoring Well	Distance from DOE Area Boundary to Monitoring Well (feet)	Constituent	Kd[a] (ml/g)	Retardation factor[b] (unitless)	Estimated Travel Time Range[c] (years)	
Domestic Septic System-1	UCD1-071	15	Aluminum	9.9	55	28	276
Domestic Septic System-3	UCD1-069	15	Formaldehyde	0.0018	1.0	0.50	5.0
		15	Molybdenum	20	111	55	553
		15	Nitrate	0	1.0	0.50	5.0
		15	Aluminum	9.9	55	28	276
		15	Silver	8.3	47	23	233
Domestic Septic System-4	UCD1-068	60	Selenium	300	1,646	3,293	32,929
		60	Aluminum	9.9	55	111	1,106
		60	Chromium	19	105	210	2,104
		60	Nickel	65	358	715	7,150
Domestic Septic System-5	UCD1-021	130	Aluminum	9.9	55	240	2,396
Domestic Septic System-6	UCD1-072	10	Aluminum	9.9	55	18	184
Dry Wells A through E	UCD1-054	0	Chromium	19	105	0	0
		0	Hexavalent chromium	19	105	0	0
		0	Mercury	52	286	0	0
		0	Molybdenum	20	111	0	0
		0	Silver	8.3	47	0	0
		0	Cesium-137	1,000	5,486	0	0
		0	Strontium-90	35	193	0	0
	UCD1-071	60	Chromium	19	105	210	2,104
		60	Hexavalent chromium	19	105	210	2,104
		60	Mercury	52	286	572	5,724
		60	Molybdenum	20	111	221	2,214
		60	Silver	8.3	47	93	930
		60	Cesium-137	1,000	5,486	10,972	109,715
		60	Strontium-90	35	193	386	3,859

Table C–1 (continued). Estimated Contaminant Migration Travel Time from DOE Areas to Monitoring Wells

DOE Area	Monitoring Well	Distance from DOE Area Boundary to Monitoring Well (feet)	Constituent	Kd[a] (ml/g)	Retardation factor[b] (unitless)	Estimated Travel Time Range[c] (years)	
Radium/Strontium Treatment System	UCD1-021	110	Nitrate	0	1.0	3.7	37
		110	Carbon-14	0	1.0	3.7	37
		110	Radium-226	450	2,469	9,054	90,535
		110	Americium-241	680	3,731	13,679	136,790
	UCD1-068	150	Nitrate	0	1.0	5.0	50
		150	Carbon-14	0	1.0	5.0	50
		150	Radium-226	450	2,469	12,346	123,457
		150	Americium-241	680	3,731	18,653	186,532
	UCD1-072	45	Nitrate	0	1.0	1.5	15
		45	Carbon-14	0	1.0	1.5	15
		45	Radium-226	450	2,469	3,704	37,037
		45	Americium-241	680	3,731	5,596	55,960
Southwest Trenches	UCD1-023	25	Nitrate	0	1.0	0.83	8.3
		25	Carbon-14	0	1.0	0.83	8.3
		25	Mercury	52	286	239	2,385
		25	Zinc	62	341	284	2,842
	UCD1-070	15	Nitrate	0	1.0	0.50	5.0
		15	Carbon-14	0	1.0	0.50	5.0
		15	Mercury	52	286	143	1,431
		15	Zinc	62	341	171	1,705
Eastern Dog Pens	UCD1-13	35	Alpha-Chlordane	140	769	897	8,970
		35	Gamma-Chlordane	280	1,537	1,793	17,929
		35	Dieldrin	43	237	276	2,763

Notes:
[a] Kd values established in DOE Areas Remedial Investigation Report (Weiss 2003).
[b] Retardation factor R = 1 + Kdrb/qs, where Kd is the sorption coefficient, rb is the soil bulk density and qs is the volumetric water content in the saturated zone. Soil bulk density (1.98 g/ml) and porosity (0.361 v/v) values are averages from nine soil samples collected in DOE areas of LEHR (DB Stephens 1996). Volumetric water content in the saturated zone assumed equal to the average soil porosity.
[c] Travel time t = LR/V, where L is the distance traveled, R is the retardation factor, and V is the groundwater seepage velocity (3 to 30 feet per year).

References:

DB Stephens (Daniel B. Stephens & Associates, Inc.), 1996. *Hydraulic Properties of LEHR/UC Davis Soil Samples*, November 12.

Weiss (Weiss Associates), 2003., *DOE Areas Remedial Investigation Report for the Laboratory for Energy-Related Health Research, University of California, Davis*, September 18.

Appendix D

Well Installation Procedures

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1.0 Well Installation Procedures

New wells will be installed in hydrostratigraphic unit (HSU)-1 for groundwater monitoring purposes.

1.1 Drilling and Well Installation

New HSU-1 wells will be installed using a hollow-stem auger drill rig to advance an 8-inch-diameter borehole for a 2-inch-diameter well to approximately 75 feet (ft) below ground surface (bgs). Soil samples from well borings will be collected and logged according to Standard Operating Procedure (SOP) 3.2, "Subsurface Soil Sampling While Drilling," and SOP 15.1, "Lithologic Logging" (Weiss 2001). The soil sample frequency will be not less than one sample per 5 ft of borehole from the surface to 45 ft bgs, with continuous soil core collected below 45 ft bgs. Soil cuttings and core generated during drilling activities shall be managed in accordance with the Soil Management Plan provided in Appendix A.

Wells will be installed in accordance with SOP 8.1, "Monitoring Well Installation." Volumes of grout, bentonite, and filter pack will be calculated based on borehole and well casing diameters. The monitoring wells will be designed and installed under the supervision of an experienced geologist working under the supervision of a California-certified professional geologist. To be consistent with previous wells, the HSU-1 wells will be constructed with threaded 2-inch-diameter schedule-40 PVC casings with 15-ft screen length. Assuming typical HSU-1 soil types are present, the wells will be constructed using 0.01-inch-slot PVC screen with a fine-grained sand pack. Soil core from the planned screened interval will be evaluated, however, and well construction will be modified if needed according to the procedure outlined in SOP 16.1, "Filter Pack and Well Screen Slot Size Determination."

Although the exact construction details will be based on the lithologic logging during drilling, the HSU-1 screened intervals are expected to extend from approximately 55 to 70 ft bgs. If the borehole is over-drilled, it will be grouted and plugged with bentonite to a depth corresponding to the depth of the well. The annular space will be filled with sand filter pack to 2 ft above the screened interval; a seal, at least 3 ft thick, consisting of hydrated bentonite chips will be placed above the filter pack, and a primary sanitary seal of neat Portland cement will be placed above the bentonite-chip seal to reach the surface. In addition to the steps outlined in SOP 8.1, the bentonite chips will be hydrated by adding water after each 4-inch-thick lift is placed to ensure hydration, unless the seal is definitely within the saturated zone. The wells will be completed with a locking well cap and either a traffic-rated flush-mount vault or a locking steel stove pipe with or without protective bollards, depending on the location.

1.2 Well Development

A minimum of 24 hours will elapse between completing the wells and beginning well development activities, to allow concrete and grout to attain sufficient strength. Well development activities will be performed at the discretion of the field geologist and hydrogeologist.

Well development will be considered complete when the water is free of sediment; when specific conductance (SC), pH, and temperature are within the stabilization goals for three consecutive readings; and when at least three times the water volume calculated to be in the well casing at the start of development has been removed. The stabilization goals are:

- Conductance: ± 10 percent.
- pH: ± 0.2.
- Temperature: ± 0.3 °C.
- Turbidity: less than 10 nephelometric turbidity units (NTUs).

If the SC, pH, and temperature do not stabilize or the turbidity is not reduced below 10 NTUs due to low recharge, well development will be considered complete when a minimum of three well casing volumes are removed and development has proceeded for at least four hours. Well development purge water and decontamination water will be discharged to the campus wastewater treatment plant.

Appendix E

Sample Collection Procedures

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1.0 Sampling Methods

Monitoring well samples will be collected according to Standard Operating Procedure 9.1, "Low-Flow Ground Water Sampling with Dedicated Pumps". A sample preparation area will be established adjacent to the well location. The work surface will be covered with plastic sheeting to minimize the potential spread of contamination. The following equipment will be staged in the sample-preparation area:

- A spill kit,
- Personal protective equipment,
- Sample containers,
- A decontamination station,
- Bailers,
- A wastewater drum,
- Custody seals, and
- Chain-of-custody forms.

The groundwater samples will be collected following EPA guidance for low-flow groundwater sampling (EPA 1996), including monitoring for specific conductance (SC), pH, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity until all are within the stabilization goals for three consecutive readings. The stabilization goals are:

- SC, ORP, DO, and turbidity: ± 10 percent.
- pH: ± 0.2.

Well purging and groundwater sample collection will be performed with dedicated bladder pumps or similar pumps suitable for low-flow purging. Sampling containers, field filtration, preservation methods (if any), and holding times will be as specified in Table E–1. All purge water and decontamination water generated during sampling will be disposed of through the campus wastewater treatment plant.

2.0 Sample Documentation

The usability of the data will depend on the data's quality. Following proper procedures for both sample collection and sample analysis reduces sampling and analytical error. To ensure sample integrity, samples will be handled using complete chain-of-custody documentation and preserved using proper sample preservation techniques, holding times, and shipment methods. Obtaining valid and comparable data also requires adequate quality assurance and quality control procedures and documentation.

Table E−1. Analytical Parameters for Groundwater Samples

Parameter	Method Reference	Container	Sample Handling/ Preservation	Reporting Limit[a]	Holding Time
Metals					
Aluminum	SW-846, Method 6020A[b]	250-milliliter polyethylene plastic	Filter[i], nitric acid, pH<2	50 µg/L	180 days
Chromium (total)				1 µg/L	
Molybdenum				1 µg/L	
Nickel				2 µg/L	
Selenium				3 µg/L	
Silver				1 µg/L	
Zinc				10 µg/L	
Mercury	SW-846, Method 7470[b]	250-milliliter polyethylene plastic	Filter[i], nitric acid, pH<2	0.2 µg/L	28 days
Hexavalent Chromium	SW-846, Method 7199[b]	250-milliliter polyethylene plastic	Filter[i], 4°C	1 µg/L	24 hours
Radionuclides					
Americium-241	EML HASL 300[c]	2-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	1 pCi/L	180 days
Cesium-137	EPA Method 901.1[d]	1-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	5 pCi/L	180 days
Strontium-90	EPA Method 905.0[e]	2-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	1 pCi/L	180 days
Carbon-14	EPA EERF C-01[f]	1-liter polyethylene plastic, glass	none	7 pCi/L	180 days
Radium-226	EPA Method 903.1[g]	1-liter polyethylene plastic, glass	Filter[i], nitric acid, pH<2	1 pCi/L	180 days
General					
Nitrate (as Nitrogen)	EPA Method 300.0[h]	250-milliliter polyethylene plastic	4°C	10 mg/L	48 hours
Formaldehyde	SW-846, Method 8315[b]	1-liter amber glass	4°C	50 µg/L	72 hours
Organics					
Alpha-Chlordane	SW-846, Method 8081[b]	1-liter amber glass (2 each)	4°C	1.0 µg/L	7 days to extraction, 40 days to analysis
Gamma-Chlordane				1.0 µg/L	
Dieldrin				0.1 µg/L	

Notes:
[a] As shown, reporting limits are at or below MCLs for all constituents and are below the previously defined background levels for all inorganics except for mercury, americium-241, cesium-137 and carbon-14. The background values for these four constituents were based on one half of the lowest background detection limits; therefore the specified reporting limits are sufficiently low for comparison with background. .
[b] From the *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 2007).
[c] From *The Procedures Manual of the Environmental Measurements Laboratory* (DOE 1997).
[d] *Gamma Emitting Radionuclides* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[e] *Radioactive Strontium* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[f] EPA, *Eastern Environmental Radiation Facility* (EERF).
[g] *Radium-226 - Radon Emanation Technique* from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).
[h] *Determination of Inorganic Anions by Ion Chromatography* (EPA 1993).
[i] Glass fiber, 0.45 micron filter
µg/L = micrograms per liter
EPA = U.S. Environmental Protection Agency
mg/L = milligrams per liter
pCi/L = picocuries per liter

The components of the sample documentation and custody system will include:

- The chain-of-custody,
- The field logbook,
- Sample numbers,
- Sample labels, and
- Custody seals.

2.1 Chain-of-Custody

Members of the sample team will complete chain-of-custody forms to track sample custody and to specify the requested analyses.

2.2 Field Logbook

Descriptions and observations made during field sampling activities will be documented in the field logbook. In addition, boring logs with lithologic classifications will be prepared from the field geologists' interpretation of the soil core recovered from well installation. The following will be recorded in the field logbook:

- The project name and number,
- The site location,
- The purpose of the sampling,
- A description of field activities,
- The names of sampling personnel,
- The date and time of entries,
- The date and time the sample was collected,
- The sample location and identification (ID) number,
- The sampling method,
- Field observations,
- The results of field measurements, and
- The results of field instrument calibrations.

2.2.1 Sample ID Numbers

All samples will be assigned a unique sample ID number (i.e., sample designation), using the following format:

GWDOEXXXX

Where

GWDOE	=	the groundwater sample associated with the DOE area; and
XXXX	=	the chronological sample number (e.g., 0017, 0018, 0019).

2.2.2 Sample Labels

Sample labels will be attached to individual sample containers and will contain the following information:

- The project number,
- The sample ID number,
- The date and time the sample was collected,
- The sampler's initials, and
- Requested analyses.

2.2.3 Custody Seals

Custody seals will be used to detect tampering and will be placed over the lid of the container and annotated with the following information:

- The project number,
- The sample ID number, and
- The date and time the sample was collected.

2.3 Data Validation and Compilation

The analytical laboratory will be contracted to deliver a detailed analytical report, including calibration data and raw data from the analysis of primary samples and quality control samples, sufficient for the reconstruction of all sample results. The project chemist or a designee who meets the qualifications requirements stated in the Quality Assurance Project Plan (QAPP) (DOE 2010) will validate the analytical results in accordance with data validation procedures defined in the QAPP. Once validated, the data will be transferred to the project database in accordance with procedures described in the QAPP.

Appendix F

Laboratory Reporting Limits

Table F−1. Reporting Limits for Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	Reporting Limit	MDL	Units
Aluminum	EPA 6020A	CalScience Environmental Lab	10.5	50	µg/L
Antimony	EPA 6020A	CalScience Environmental Lab	1	0.38	µg/L
Arsenic	EPA 6020A	CalScience Environmental Lab	1	0.589	µg/L
Barium	EPA 6020A	CalScience Environmental Lab	1	0.105	µg/L
Beryllium	EPA 6020A	CalScience Environmental Lab	1	0.131	µg/L
Cadmium	EPA 6020A	CalScience Environmental Lab	1	0.266	µg/L
Chromium, total	EPA 6020A	CalScience Environmental Lab	1	0.618	µg/L
Cobalt	EPA 6020A	CalScience Environmental Lab	1	0.14	µg/L
Copper	EPA 6020A	CalScience Environmental Lab	1	0.105	µg/L
Iron	EPA 6020A	CalScience Environmental Lab	100	6.67	µg/L
Lead	EPA 6020A	CalScience Environmental Lab	1	0.17	µg/L
Manganese	EPA 6020A	CalScience Environmental Lab	1	0.62	µg/L
Molybdenum	EPA 6020A	CalScience Environmental Lab	1	0.29	µg/L
Nickel	EPA 6020A	CalScience Environmental Lab	1	0.155	µg/L
Selenium	EPA 6020A	CalScience Environmental Lab	1	0.554	µg/L
Silver	EPA 6020A	CalScience Environmental Lab	1	0.12	µg/L
Thallium	EPA 6020A	CalScience Environmental Lab	1	0.498	µg/L
Vanadium	EPA 6020A	CalScience Environmental Lab	1	0.79	µg/L
Zinc	EPA 6020A	CalScience Environmental Lab	5	1.8	µg/L
Mercury	EPA 7470	CalScience Environmental Lab	0.2	0.0177	µg/L
Chromium, hexavalent	EPA 7199	CalScience Environmental Lab	1	0.12	µg/L
Americium-241	EML HASL 300	GEL Laboratories	1	1	pCi/L
Cesium-137	EPA 901.1	GEL Laboratories	5	5	pCi/L
Tritium	EPA 906.0	GEL Laboratories	220	220	pCi/L
Strontium-90	EPA 905.0	GEL Laboratories	1	1	pCi/L
Gross Alpha	EPA 900.0	GEL Laboratories	2	2	pCi/L
Gross Beta	EPA 900.0	GEL Laboratories	3	3	pCi/L
Carbon-14	EPA EERF C-01	GEL Laboratories	7	7	pCi/L
Radium-226	EPA 903.1	GEL Laboratories	1	1	pCi/L

Table F–1 (continued). Reporting Limits for Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	Reporting Limit	MDL	Units
Uranium-235	EPA 901.1	GEL Laboratories	1	1	pCi/L
Uranium-238	EPA 901.1	GEL Laboratories	1	1	pCi/L
Nitrate (as Nitrogen)	EPA 300.0	CalScience Environmental Lab	100	17	µg/L
Formaldehyde	EPA 8315	TestAmerica North Canton	50	21	µg/L
1,1,1,2-Tetrachloroethane	EPA 8260C	CalScience Environmental Lab	1	0.35	µg/L
1,1,1-Trichloroethane	EPA 8260C	CalScience Environmental Lab	1	0.45	µg/L
1,1,2,2-Tetrachloroethane	EPA 8260C	CalScience Environmental Lab	1	0.44	µg/L
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C	CalScience Environmental Lab	10	0.64	µg/L
1,1,2-Trichloroethane	EPA 8260C	CalScience Environmental Lab	1	0.54	µg/L
1,1-Dichloroethane	EPA 8260C	CalScience Environmental Lab	1	0.37	µg/L
1,1-Dichloroethene	EPA 8260C	CalScience Environmental Lab	1	0.4	µg/L
1,1-Dichloropropene	EPA 8260C	CalScience Environmental Lab	1	0.26	µg/L
1,2,3-Trichlorobenzene	EPA 8260C	CalScience Environmental Lab	1	0.31	µg/L
1,2,3-Trichloropropane	EPA 8260C	CalScience Environmental Lab	5	1.3	µg/L
1,2,4-Trichlorobenzene	EPA 8260C	CalScience Environmental Lab	1	0.49	µg/L
1,2,4-Trimethylbenzene	EPA 8260C	CalScience Environmental Lab	1	0.24	µg/L
1,2-Dibromo-3-Chloropropane	EPA 8260C	CalScience Environmental Lab	5	3.1	µg/L
1,2-Dibromoethane	EPA 8260C	CalScience Environmental Lab	1	0.47	µg/L
1,2-Dichlorobenzene	EPA 8260C	CalScience Environmental Lab	1	0.27	µg/L
1,2-Dichloroethane	EPA 8260C	CalScience Environmental Lab	0.5	0.31	µg/L
1,2-Dichloropropane	EPA 8260C	CalScience Environmental Lab	1	0.38	µg/L
1,3,5-Trimethylbenzene	EPA 8260C	CalScience Environmental Lab	1	0.23	µg/L
1,3-Dichlorobenzene	EPA 8260C	CalScience Environmental Lab	1	0.28	µg/L
1,3-Dichloropropane	EPA 8260C	CalScience Environmental Lab	1	0.38	µg/L
1,4-Dichlorobenzene	EPA 8260C	CalScience Environmental Lab	1	0.21	µg/L
2,2-Dichloropropane	EPA 8260C	CalScience Environmental Lab	1	0.46	µg/L
2-Butanone	EPA 8260C	CalScience Environmental Lab	10	6.9	µg/L
2-Chlorotoluene	EPA 8260C	CalScience Environmental Lab	1	0.55	µg/L
2-Hexanone	EPA 8260C	CalScience Environmental Lab	10	6.9	µg/L

Table F−1 (continued). Reporting Limits for Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	Reporting Limit	MDL	Units
4-Chlorotoluene	EPA 8260C	CalScience Environmental Lab	1	0.21	µg/L
4-Methyl-2-Pentanone	EPA 8260C	CalScience Environmental Lab	10	4.4	µg/L
Acetone	EPA 8260C	CalScience Environmental Lab	50	20	µg/L
Benzene	EPA 8260C	CalScience Environmental Lab	0.5	0.28	µg/L
Bromobenzene	EPA 8260C	CalScience Environmental Lab	1	0.33	µg/L
Bromochloromethane	EPA 8260C	CalScience Environmental Lab	1	0.69	µg/L
Bromodichloromethane	EPA 8260C	CalScience Environmental Lab	1	0.33	µg/L
Bromoform	EPA 8260C	CalScience Environmental Lab	1	0.55	µg/L
Bromomethane	EPA 8260C	CalScience Environmental Lab	10	4.3	µg/L
c-1,2-Dichloroethene	EPA 8260C	CalScience Environmental Lab	1	0.49	µg/L
c-1,3-Dichloropropene	EPA 8260C	CalScience Environmental Lab	0.5	0.28	µg/L
Carbon Disulfide	EPA 8260C	CalScience Environmental Lab	10	1.9	µg/L
Carbon Tetrachloride	EPA 8260C	CalScience Environmental Lab	0.5	0.43	µg/L
Chlorobenzene	EPA 8260C	CalScience Environmental Lab	1	0.22	µg/L
Chloroethane	EPA 8260C	CalScience Environmental Lab	5	1.3	µg/L
Chloroform	EPA 8260C	CalScience Environmental Lab	1	0.33	µg/L
Chloromethane	EPA 8260C	CalScience Environmental Lab	10	0.49	µg/L
Dibromochloromethane	EPA 8260C	CalScience Environmental Lab	1	0.48	µg/L
Dibromomethane	EPA 8260C	CalScience Environmental Lab	1	0.59	µg/L
Dichlorodifluoromethane	EPA 8260C	CalScience Environmental Lab	1	0.49	µg/L
Ethylbenzene	EPA 8260C	CalScience Environmental Lab	1	0.22	µg/L
Isopropylbenzene	EPA 8260C	CalScience Environmental Lab	1	0.23	µg/L
Methylene Chloride	EPA 8260C	CalScience Environmental Lab	10	2.6	µg/L
Methyl-t-Butyl Ether (MTBE)	EPA 8260C	CalScience Environmental Lab	1	0.3	µg/L
Naphthalene	EPA 8260C	CalScience Environmental Lab	10	2.5	µg/L
n-Butylbenzene	EPA 8260C	CalScience Environmental Lab	1	0.28	µg/L
n-Propylbenzene	EPA 8260C	CalScience Environmental Lab	1	0.79	µg/L
o-Xylene	EPA 8260C	CalScience Environmental Lab	1	0.24	µg/L

Table F−1 (continued). Reporting Limits for Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	Reporting Limit	MDL	Units
p/m-Xylene	EPA 8260C	CalScience Environmental Lab	1	0.45	µg/L
p-Isopropyltoluene	EPA 8260C	CalScience Environmental Lab	1	0.26	µg/L
sec-Butylbenzene	EPA 8260C	CalScience Environmental Lab	1	0.2	µg/L
Styrene	EPA 8260C	CalScience Environmental Lab	1	0.3	µg/L
t-1,2-Dichloroethene	EPA 8260C	CalScience Environmental Lab	1	0.4	µg/L
t-1,3-Dichloropropene	EPA 8260C	CalScience Environmental Lab	0.5	0.36	µg/L
tert-Butylbenzene	EPA 8260C	CalScience Environmental Lab	1	0.28	µg/L
Tetrachloroethene	EPA 8260C	CalScience Environmental Lab	1	0.51	µg/L
Toluene	EPA 8260C	CalScience Environmental Lab	1	0.33	µg/L
Trichloroethene	EPA 8260C	CalScience Environmental Lab	1	0.3	µg/L
Trichlorofluoromethane	EPA 8260C	CalScience Environmental Lab	10	0.31	µg/L
Vinyl Acetate	EPA 8260C	CalScience Environmental Lab	10	7.1	µg/L
Vinyl Chloride	EPA 8260C	CalScience Environmental Lab	0.5	0.33	µg/L
1,2-Dichloroethane-d4	EPA 8260C	CalScience Environmental Lab	1	4.1	µg/L
1,4-Bromofluorobenzene	EPA 8260C	CalScience Environmental Lab	0	2.3	µg/L
Dibromofluoromethane	EPA 8260C	CalScience Environmental Lab	0.5	3	µg/L
Toluene-d8	EPA 8260C	CalScience Environmental Lab	0	5.8	µg/L
1,2,4-Trichlorobenzene	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
1,2-Dichlorobenzene	EPA 8270C	CalScience Environmental Lab	10	1.1	µg/L
1,3-Dichlorobenzene	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
1,4-Dichlorobenzene	EPA 8270C	CalScience Environmental Lab	10	1.1	µg/L
1-Methylnaphthalene	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
2,4,5-Trichlorophenol	EPA 8270C	CalScience Environmental Lab	10	0.97	µg/L
2,4,6-Trichlorophenol	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
2,4-Dichlorophenol	EPA 8270C	CalScience Environmental Lab	10	1.1	µg/L
2,4-Dimethylphenol	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
2,4-Dinitrophenol	EPA 8270C	CalScience Environmental Lab	50	2.6	µg/L
2,4-Dinitrotoluene	EPA 8270C	CalScience Environmental Lab	10	1	µg/L
2,6-Dinitrotoluene	EPA 8270C	CalScience Environmental Lab	10	1.1	µg/L

Table F−1 (continued). Reporting Limits for Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	Reporting Limit	MDL	Units
2-Chloronaphthalene	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
2-Chlorophenol	EPA 8270C	CalScience Environmental Lab	10	1	µg/L
2-Methylnaphthalene	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
2-Methylphenol	EPA 8270C	CalScience Environmental Lab	10	1.1	µg/L
2-Nitroaniline	EPA 8270C	CalScience Environmental Lab	10	1	µg/L
2-Nitrophenol	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
3,3'-Dichlorobenzidine	EPA 8270C	CalScience Environmental Lab	25	1.3	µg/L
3/4-Methylphenol	EPA 8270C	CalScience Environmental Lab	10	1	µg/L
3-Nitroaniline	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
4,6-Dinitro-2-Methylphenol	EPA 8270C	CalScience Environmental Lab	50	3.4	µg/L
4-Bromophenyl-Phenyl Ether	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
4-Chloro-3-Methylphenol	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
4-Chloroaniline	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
4-Chlorophenyl-Phenyl Ether	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
4-Nitroaniline	EPA 8270C	CalScience Environmental Lab	10	2.4	µg/L
4-Nitrophenol	EPA 8270C	CalScience Environmental Lab	10	0.86	µg/L
Acenaphthene	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
Acenaphthylene	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
Aniline	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
Anthracene	EPA 8270C	CalScience Environmental Lab	10	1.5	µg/L
Azobenzene	EPA 8270C	CalScience Environmental Lab	10	1.7	µg/L
Benzidine	EPA 8270C	CalScience Environmental Lab	50	0.62	µg/L
Benzo (a) Anthracene	EPA 8270C	CalScience Environmental Lab	10	1.1	µg/L
Benzo (a) Pyrene	EPA 8270C	CalScience Environmental Lab	10	0.88	µg/L
Benzo (b) Fluoranthene	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
Benzo (g,h,i) Perylene	EPA 8270C	CalScience Environmental Lab	10	0.71	µg/L
Benzo (k) Fluoranthene	EPA 8270C	CalScience Environmental Lab	10	1.7	µg/L
Benzoic Acid	EPA 8270C	CalScience Environmental Lab	50	0.43	µg/L
Benzyl Alcohol	EPA 8270C	CalScience Environmental Lab	10	1	µg/L

Table F−1 (continued). Reporting Limits for Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	Reporting Limit	MDL	Units
Bis(2-Chloroethoxy) Methane	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
Bis(2-Chloroethyl) Ether	EPA 8270C	CalScience Environmental Lab	25	1	µg/L
Bis(2-Chloroisopropyl) Ether	EPA 8270C	CalScience Environmental Lab	10	1.5	µg/L
Bis(2-Ethylhexyl) Phthalate	EPA 8270C	CalScience Environmental Lab	10	1	µg/L
Butyl Benzyl Phthalate	EPA 8270C	CalScience Environmental Lab	10	1	µg/L
Carbazole	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
Chrysene	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
Dibenz (a,h) Anthracene	EPA 8270C	CalScience Environmental Lab	10	0.82	µg/L
Dibenzofuran	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
Diethyl Phthalate	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
Dimethyl Phthalate	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
Di-n-Butyl Phthalate	EPA 8270C	CalScience Environmental Lab	10	1.5	µg/L
Di-n-Octyl Phthalate	EPA 8270C	CalScience Environmental Lab	10	1	µg/L
Fluoranthene	EPA 8270C	CalScience Environmental Lab	10	1.5	µg/L
Fluorene	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
Hexachloro-1,3-Butadiene	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
Hexachlorobenzene	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
Hexachlorocyclopentadiene	EPA 8270C	CalScience Environmental Lab	25	0.44	µg/L
Hexachloroethane	EPA 8270C	CalScience Environmental Lab	10	0.98	µg/L
Indeno (1,2,3-c,d) Pyrene	EPA 8270C	CalScience Environmental Lab	10	0.83	µg/L
Isophorone	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
Methapyrilene	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
Methyl Parathion	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
Naphthalene	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
Nitrobenzene	EPA 8270C	CalScience Environmental Lab	25	1.3	µg/L
N-Nitrosodimethylamine	EPA 8270C	CalScience Environmental Lab	10	1.1	µg/L
N-Nitroso-di-n-propylamine	EPA 8270C	CalScience Environmental Lab	10	1.3	µg/L
N-Nitrosodiphenylamine	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L

Table F−1 (continued). Reporting Limits for Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	Reporting Limit	MDL	Units
Pentachlorophenol	EPA 8270C	CalScience Environmental Lab	10	0.75	µg/L
Phenanthrene	EPA 8270C	CalScience Environmental Lab	10	1.5	µg/L
Phenol	EPA 8270C	CalScience Environmental Lab	10	1.2	µg/L
Pyrene	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
Pyridine	EPA 8270C	CalScience Environmental Lab	10	1.4	µg/L
Total PAHs	EPA 8270C	CalScience Environmental Lab	10	1.7	µg/L
2,4,6-Tribromophenol	EPA 8270C	CalScience Environmental Lab	0	1.1	µg/L
2-Fluorobiphenyl	EPA 8270C	CalScience Environmental Lab	0	1.3	µg/L
2-Fluorophenol	EPA 8270C	CalScience Environmental Lab	0	0.96	µg/L
Nitrobenzene-d5	EPA 8270C	CalScience Environmental Lab	0	1.3	µg/L
Phenol-d6	EPA 8270C	CalScience Environmental Lab	0	0.96	µg/L
p-Terphenyl-d14	EPA 8270C	CalScience Environmental Lab	0	1.4	µg/L
4,4'-DDD	EPA 8081B	CalScience Environmental Lab	0.1	0.024	µg/L
4,4'-DDE	EPA 8081B	CalScience Environmental Lab	0.1	0.023	µg/L
4,4'-DDT	EPA 8081B	CalScience Environmental Lab	0.1	0.017	µg/L
Aldrin	EPA 8081B	CalScience Environmental Lab	0.1	0.021	µg/L
Alpha-BHC	EPA 8081B	CalScience Environmental Lab	0.1	0.025	µg/L
Beta-BHC	EPA 8081B	CalScience Environmental Lab	0.1	0.018	µg/L
Chlordane	EPA 8081B	CalScience Environmental Lab	1	0.17	µg/L
Delta-BHC	EPA 8081B	CalScience Environmental Lab	0.1	0.032	µg/L
Dieldrin	EPA 8081B	CalScience Environmental Lab	0.1	0.024	µg/L
Endosulfan I	EPA 8081B	CalScience Environmental Lab	0.1	0.01	µg/L
Endosulfan II	EPA 8081B	CalScience Environmental Lab	0.1	0.022	µg/L
Endosulfan Sulfate	EPA 8081B	CalScience Environmental Lab	0.1	0.015	µg/L
Endrin	EPA 8081B	CalScience Environmental Lab	0.1	0.016	µg/L
Endrin Aldehyde	EPA 8081B	CalScience Environmental Lab	0.1	0.0092	µg/L
Endrin Ketone	EPA 8081B	CalScience Environmental Lab	0.1	0.011	µg/L
Gamma-BHC	EPA 8081B	CalScience Environmental Lab	0.1	0.026	µg/L
Heptachlor	EPA 8081B	CalScience Environmental Lab	0.1	0.0096	µg/L
Heptachlor Epoxide	EPA 8081B	CalScience Environmental Lab	0.1	0.017	µg/L

Table F−1 (continued). Reporting Limits for Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	Reporting Limit	MDL	Units
Methoxychlor	EPA 8081B	CalScience Environmental Lab	0.1	0.028	µg/L
Toxaphene	EPA 8081B	CalScience Environmental Lab	2	0.61	µg/L
2,4,5,6-Tetrachloro-m-Xylene	EPA 8081B	CalScience Environmental Lab	0	0	µg/L
Decachlorobiphenyl	EPA 8081B	CalScience Environmental Lab	0	0	µg/L
Aroclor-1016	EPA 8082	CalScience Environmental Lab	1	0.15	µg/L
Aroclor-1221	EPA 8082	CalScience Environmental Lab	1	0.1	µg/L
Aroclor-1232	EPA 8082	CalScience Environmental Lab	1	0.1	µg/L
Aroclor-1242	EPA 8082	CalScience Environmental Lab	1	0.1	µg/L
Aroclor-1248	EPA 8082	CalScience Environmental Lab	1	0.1	µg/L
Aroclor-1254	EPA 8082	CalScience Environmental Lab	1	0.1	µg/L
Aroclor-1260	EPA 8082	CalScience Environmental Lab	1	0.25	µg/L
Aroclor-1262	EPA 8082	CalScience Environmental Lab	1	0.1	µg/L
2,4,5,6-Tetrachloro-m-Xylene	EPA 8082	CalScience Environmental Lab	0	0	µg/L
Decachlorobiphenyl	EPA 8082	CalScience Environmental Lab	0	0	µg/L

Abbreviations:

EERF Eastern Environmental Radiation Facility
EML HASL Analytical procedure from *The Procedures Manual of the Environmental Measurements Laboratory* (DOE 1997).
EPA Environmental Protection Agency
MDL method detection limit
pCi/L picocuries per liter
µg/L micrograms per liter

Table F–2. Quality Control Limits for Groundwater Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	MS CL	MS RPD	LCS CL	LCS RPD
Aluminum	EPA 6020A	CalScience Environmental Lab	47–161	0–24	80–120	0–20
Antimony	EPA 6020A	CalScience Environmental Lab	1–97	0–39	80–120	0–20
Arsenic	EPA 6020A	CalScience Environmental Lab	72–132	0–13	80–120	0–20
Barium	EPA 6020A	CalScience Environmental Lab	50–152	0–41	80–120	0–20
Beryllium	EPA 6020A	CalScience Environmental Lab	56–122	0–11	80–120	0–20
Cadmium	EPA 6020A	CalScience Environmental Lab	85–121	0–12	80–120	0–20
Chromium	EPA 6020A	CalScience Environmental Lab	73–133	0–11	80–120	0–20
Cobalt	EPA 6020A	CalScience Environmental Lab	79–121	0–10	80–120	0–20
Copper	EPA 6020A	CalScience Environmental Lab	25–157	0–22	80–120	0–20
Iron	EPA 6020A	CalScience Environmental Lab	80–120	0–20	80–120	0–20
Lead	EPA 6020A	CalScience Environmental Lab	79–121	0–10	80–120	0–20
Manganese	EPA 6020A	CalScience Environmental Lab	72–126	0–42	80–120	0–20
Mercury	EPA 7470A	CalScience Environmental Lab	57–141	0–10	85–121	0–10
Molybdenum	EPA 6020A	CalScience Environmental Lab	83–137	0–10	80–120	0–20
Nickel	EPA 6020A	CalScience Environmental Lab	68–122	0–10	80–120	0–20
Selenium	EPA 6020A	CalScience Environmental Lab	59–125	0–12	80–120	0–20
Silver	EPA 6020A	CalScience Environmental Lab	68–128	0–14	80–120	0–20
Thallium	EPA 6020A	CalScience Environmental Lab	79–115	0–11	80–120	0–20
Vanadium	EPA 6020A	CalScience Environmental Lab	77–137	0–15	80–120	0–20
Zinc	EPA 6020A	CalScience Environmental Lab	43–145	0–39	80–120	0–20
Chromium, hexavalent	EPA 7199	CalScience Environmental Lab	70–130	0–25	80–120	0–20
Americium-241	EML HASL 300	GEL Laboratories	75–125	0–20	75–125	0–20
Cesium-137	EPA 901.1	GEL Laboratories	75–125	0–20	75–125	0–20
Tritium	EPA 906.0	GEL Laboratories	75–125	0–20	75–125	0–20
Strontium-90	EPA 905.0	GEL Laboratories	75–125	0–20	75–125	0–20
Gross Alpha	EPA 900.0	GEL Laboratories	75–125	0–20	75–125	0–20
Gross Beta	EPA 900.0	GEL Laboratories	75–125	0–20	75–125	0–20
Carbon-14	EPA EERF C-01	GEL Laboratories	75–125	0–20	75–125	0–20

Table F–2 (continued). Quality Control Limits for Groundwater Monitoring Parameters, DOE LEHR

Parameter	Method Reference	Laboratory	MS CL	MS RPD	LCS CL	LCS RPD
Radium-226	EPA 903.1	GEL Laboratories	75–125	0–20	75–125	0–20
Uranium-235	EPA 901.1	GEL Laboratories				
Uranium-238	EPA 901.1	GEL Laboratories	75–125	0–20	75–125	0–20
Nitrate (as Nitrogen)	EPA 300.0	CalScience Environmental Lab	80–120	0–20	90–110	0–15
Formaldehyde	EPA 8315	TestAmerica North Canton	50–150	0–50	50–150	0–50
1,1,1,2-Tetrachloroethane	EPA 8260C	CalScience Environmental Lab				
1,1,1-Trichloroethane	EPA 8260C	CalScience Environmental Lab				
1,1,2,2-Tetrachloroethane	EPA 8260C	CalScience Environmental Lab				
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C	CalScience Environmental Lab				
1,1,2-Trichloroethane	EPA 8260C	CalScience Environmental Lab				
1,1-Dichloroethane	EPA 8260C	CalScience Environmental Lab				
1,1-Dichloroethene	EPA 8260C	CalScience Environmental Lab	69–129	0–20	71–125	0–25
1,1-Dichloropropene	EPA 8260C	CalScience Environmental Lab				
1,2,3-Trichlorobenzene	EPA 8260C	CalScience Environmental Lab				
1,2,3-Trichloropropane	EPA 8260C	CalScience Environmental Lab				
1,2,4-Trichlorobenzene	EPA 8260C	CalScience Environmental Lab				
1,2,4-Trimethylbenzene	EPA 8260C	CalScience Environmental Lab				
1,2-Dibromo-3-Chloropropane	EPA 8260C	CalScience Environmental Lab				
1,2-Dibromoethane	EPA 8260C	CalScience Environmental Lab	77–125	0–20	80–120	0–20
1,2-Dichlorobenzene	EPA 8260C	CalScience Environmental Lab	78–120	0–20	79–120	0–20
1,2-Dichloroethane	EPA 8260C	CalScience Environmental Lab	80–120	0–20	80–120	0–20
1,2-Dichloropropane	EPA 8260C	CalScience Environmental Lab				
1,3,5-Trimethylbenzene	EPA 8260C	CalScience Environmental Lab				
1,3-Dichlorobenzene	EPA 8260C	CalScience Environmental Lab				
1,3-Dichloropropane	EPA 8260C	CalScience Environmental Lab				
1,4-Dichlorobenzene	EPA 8260C	CalScience Environmental Lab				
2,2-Dichloropropane	EPA 8260C	CalScience Environmental Lab				
2-Butanone	EPA 8260C	CalScience Environmental Lab				
2-Chlorotoluene	EPA 8260C	CalScience Environmental Lab				

Table F–2 (continued). Quality Control Limits for Groundwater Monitoring Parameters DOE LEHR

Parameter	Method Reference	Laboratory	MS CL	MS RPD	LCS CL	LCS RPD
2-Hexanone	EPA 8260C	CalScience Environmental Lab				
4-Chlorotoluene	EPA 8260C	CalScience Environmental Lab				
4-Methyl-2-Pentanone	EPA 8260C	CalScience Environmental Lab				
Acetone	EPA 8260C	CalScience Environmental Lab				
Benzene	EPA 8260C	CalScience Environmental Lab	80–120	0–20	80–120	0–20
Bromobenzene	EPA 8260C	CalScience Environmental Lab				
Bromochloromethane	EPA 8260C	CalScience Environmental Lab				
Bromodichloromethane	EPA 8260C	CalScience Environmental Lab				
Bromoform	EPA 8260C	CalScience Environmental Lab				
Bromomethane	EPA 8260C	CalScience Environmental Lab				
c-1,2-Dichloroethene	EPA 8260C	CalScience Environmental Lab				
c-1,3-Dichloropropene	EPA 8260C	CalScience Environmental Lab				
Carbon Disulfide	EPA 8260C	CalScience Environmental Lab				
Carbon Tetrachloride	EPA 8260C	CalScience Environmental Lab	55–151	0–20	67–139	0–22
Chlorobenzene	EPA 8260C	CalScience Environmental Lab	80–120	0–20	80–120	0–20
Chloroethane	EPA 8260C	CalScience Environmental Lab				
Chloroform	EPA 8260C	CalScience Environmental Lab				
Chloromethane	EPA 8260C	CalScience Environmental Lab				
Dibromochloromethane	EPA 8260C	CalScience Environmental Lab				
Dibromomethane	EPA 8260C	CalScience Environmental Lab				
Dichlorodifluoromethane	EPA 8260C	CalScience Environmental Lab				
Ethylbenzene	EPA 8260C	CalScience Environmental Lab	73–127	0–20	80–123	0–20
Isopropylbenzene	EPA 8260C	CalScience Environmental Lab				
Methylene Chloride	EPA 8260C	CalScience Environmental Lab				
Methyl-t-Butyl Ether (MTBE)	EPA 8260C	CalScience Environmental Lab	65–131	0–22	75–123	0–25
Naphthalene	EPA 8260C	CalScience Environmental Lab				
n-Butylbenzene	EPA 8260C	CalScience Environmental Lab				
n-Propylbenzene	EPA 8260C	CalScience Environmental Lab				
o-Xylene	EPA 8260C	CalScience Environmental Lab				

Table F–2 (continued). Quality Control Limits for Groundwater Monitoring Parameters DOE LEHR

Parameter	Method Reference	Laboratory	MS CL	MS RPD	LCS CL	LCS RPD
p/m-Xylene	EPA 8260C	CalScience Environmental Lab				
p-Isopropyltoluene	EPA 8260C	CalScience Environmental Lab				
sec-Butylbenzene	EPA 8260C	CalScience Environmental Lab				
Styrene	EPA 8260C	CalScience Environmental Lab				
t-1,2-Dichloroethene	EPA 8260C	CalScience Environmental Lab				
t-1,3-Dichloropropene	EPA 8260C	CalScience Environmental Lab				
tert-Butylbenzene	EPA 8260C	CalScience Environmental Lab				
Tetrachloroethene	EPA 8260C	CalScience Environmental Lab				
Toluene	EPA 8260C	CalScience Environmental Lab	80–120	0–20	80–120	0–20
Trichloroethene	EPA 8260C	CalScience Environmental Lab	67–133	0–20	80–120	0–20
Trichlorofluoromethane	EPA 8260C	CalScience Environmental Lab				
Vinyl Acetate	EPA 8260C	CalScience Environmental Lab				
Vinyl Chloride	EPA 8260C	CalScience Environmental Lab	67–133	0–20	68–140	0–23
1,2-Dichloroethane-d4	EPA 8260C	CalScience Environmental Lab	80–131		80–131	
1,4-Bromofluorobenzene	EPA 8260C	CalScience Environmental Lab	80–120		80–120	
Dibromofluoromethane	EPA 8260C	CalScience Environmental Lab	80–126		80–126	
1,2,4-Trichlorobenzene	EPA 8270C	CalScience Environmental Lab	28–136	0–27	49–121	0–19
1,2-Dichlorobenzene	EPA 8270C	CalScience Environmental Lab				
1,3-Dichlorobenzene	EPA 8270C	CalScience Environmental Lab				
1,4-Dichlorobenzene	EPA 8270C	CalScience Environmental Lab	13–145	0–26	50–122	0–19
1-Methylnaphthalene	EPA 8270C	CalScience Environmental Lab				
2,4,5-Trichlorophenol	EPA 8270C	CalScience Environmental Lab				
2,4,6-Trichlorophenol	EPA 8270C	CalScience Environmental Lab				
2,4-Dichlorophenol	EPA 8270C	CalScience Environmental Lab				
2,4-Dimethylphenol	EPA 8270C	CalScience Environmental Lab				
2,4-Dinitrophenol	EPA 8270C	CalScience Environmental Lab				
2,4-Dinitrotoluene	EPA 8270C	CalScience Environmental Lab	54–144	0–17	41–161	0–22
2,6-Dinitrotoluene	EPA 8270C	CalScience Environmental Lab				

Table F–2 (continued). Quality Control Limits for Groundwater Monitoring Parameters DOE LEHR

Parameter	Method Reference	Laboratory	MS CL	MS RPD	LCS CL	LCS RPD
2-Chloronaphthalene	EPA 8270C	CalScience Environmental Lab				
2-Chlorophenol	EPA 8270C	CalScience Environmental Lab	48–120	0–26	53–113	0–17
2-Methylnaphthalene	EPA 8270C	CalScience Environmental Lab				
2-Methylphenol	EPA 8270C	CalScience Environmental Lab				
2-Nitroaniline	EPA 8270C	CalScience Environmental Lab				
2-Nitrophenol	EPA 8270C	CalScience Environmental Lab				
3,3'-Dichlorobenzidine	EPA 8270C	CalScience Environmental Lab				
3/4-Methylphenol	EPA 8270C	CalScience Environmental Lab				
3-Nitroaniline	EPA 8270C	CalScience Environmental Lab				
4,6-Dinitro-2-Methylphenol	EPA 8270C	CalScience Environmental Lab				
4-Bromophenyl-Phenyl Ether	EPA 8270C	CalScience Environmental Lab				
4-Chloro-3-Methylphenol	EPA 8270C	CalScience Environmental Lab	58–130	0–27	55–121	0–18
4-Chloroaniline	EPA 8270C	CalScience Environmental Lab				
4-Chlorophenyl-Phenyl Ether	EPA 8270C	CalScience Environmental Lab				
4-Nitroaniline	EPA 8270C	CalScience Environmental Lab				
4-Nitrophenol	EPA 8270C	CalScience Environmental Lab	8–176	0–34	1–145	0–29
Acenaphthene	EPA 8270C	CalScience Environmental Lab	46–136	0–19	55–139	0–17
Acenaphthylene	EPA 8270C	CalScience Environmental Lab	50–150	0–20	33–145	0–20
Aniline	EPA 8270C	CalScience Environmental Lab				
Anthracene	EPA 8270C	CalScience Environmental Lab				
Azobenzene	EPA 8270C	CalScience Environmental Lab				
Benzidine	EPA 8270C	CalScience Environmental Lab				
Benzo (a) Anthracene	EPA 8270C	CalScience Environmental Lab				
Benzo (a) Pyrene	EPA 8270C	CalScience Environmental Lab				
Benzo (b) Fluoranthene	EPA 8270C	CalScience Environmental Lab				
Benzo (g,h,i) Perylene	EPA 8270C	CalScience Environmental Lab				
Benzo (k) Fluoranthene	EPA 8270C	CalScience Environmental Lab				
Benzoic Acid	EPA 8270C	CalScience Environmental Lab				

Table F–2 (continued). Quality Control Limits for Groundwater Monitoring Parameters DOE LEHR

Parameter	Method Reference	Laboratory	MS CL	MS RPD	LCS CL	LCS RPD
Benzyl Alcohol	EPA 8270C	CalScience Environmental Lab				
Bis(2-Chloroethoxy) Methane	EPA 8270C	CalScience Environmental Lab				
Bis(2-Chloroethyl) Ether	EPA 8270C	CalScience Environmental Lab				
Bis(2-Chloroisopropyl) Ether	EPA 8270C	CalScience Environmental Lab				
Bis(2-Ethylhexyl) Phthalate	EPA 8270C	CalScience Environmental Lab				
Butyl Benzyl Phthalate	EPA 8270C	CalScience Environmental Lab	50–150	0–20	0–152	0–20
Carbazole	EPA 8270C	CalScience Environmental Lab				
Chrysene	EPA 8270C	CalScience Environmental Lab				
Dibenz (a,h) Anthracene	EPA 8270C	CalScience Environmental Lab				
Dibenzofuran	EPA 8270C	CalScience Environmental Lab				
Diethyl Phthalate	EPA 8270C	CalScience Environmental Lab				
Dimethyl Phthalate	EPA 8270C	CalScience Environmental Lab	50–150	0–20	0–112	0–20
Di-n-Butyl Phthalate	EPA 8270C	CalScience Environmental Lab				
Di-n-Octyl Phthalate	EPA 8270C	CalScience Environmental Lab				
Fluoranthene	EPA 8270C	CalScience Environmental Lab				
Fluorene	EPA 8270C	CalScience Environmental Lab	50–150	0–20	59–121	0–20
Hexachloro-1,3-Butadiene	EPA 8270C	CalScience Environmental Lab				
Hexachlorobenzene	EPA 8270C	CalScience Environmental Lab				
Hexachlorocyclopentadiene	EPA 8270C	CalScience Environmental Lab				
Hexachloroethane	EPA 8270C	CalScience Environmental Lab				
Indeno (1,2,3-c,d) Pyrene	EPA 8270C	CalScience Environmental Lab				
Isophorone	EPA 8270C	CalScience Environmental Lab				
Methapyrilene	EPA 8270C	CalScience Environmental Lab				
Methyl Parathion	EPA 8270C	CalScience Environmental Lab				
Naphthalene	EPA 8270C	CalScience Environmental Lab	50–150	0–20	21–133	0–20
Nitrobenzene	EPA 8270C	CalScience Environmental Lab				
N-Nitrosodimethylamine	EPA 8270C	CalScience Environmental Lab				
N-Nitroso-di-n-propylamine	EPA 8270C	CalScience Environmental Lab	60–144	0–40	56–146	0–22
N-Nitrosodiphenylamine	EPA 8270C	CalScience Environmental Lab				

Table F–2 (continued). Quality Control Limits for Groundwater Monitoring Parameters DOE LEHR

Parameter	Method Reference	Laboratory	MS CL	MS RPD	LCS CL	LCS RPD
Pentachlorophenol	EPA 8270C	CalScience Environmental Lab	52–136	0–35	34–130	0–23
Phenanthrene	EPA 8270C	CalScience Environmental Lab				
Phenol	EPA 8270C	CalScience Environmental Lab	6–138	0–39	4–142	0–24
Pyrene	EPA 8270C	CalScience Environmental Lab	39–165	0–56	38–170	0–27
Pyridine	EPA 8270C	CalScience Environmental Lab				
Total PAHs	EPA 8270C	CalScience Environmental Lab				
2,4,6-Tribromophenol	EPA 8270C	CalScience Environmental Lab	41–137		41–137	
2-Fluorobiphenyl	EPA 8270C	CalScience Environmental Lab	42–138		42–138	
2-Fluorophenol	EPA 8270C	CalScience Environmental Lab	7–121		7–121	
Nitrobenzene-d5	EPA 8270C	CalScience Environmental Lab	50–146		50–146	
Phenol-d6	EPA 8270C	CalScience Environmental Lab	1–127		1–127	
p-Terphenyl-d14	EPA 8270C	CalScience Environmental Lab	47–173		47–173	
4,4'-DDD	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
4,4'-DDE	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
4,4'-DDT	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Aldrin	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Alpha-BHC	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Beta-BHC	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Chlordane	EPA 8081B	CalScience Environmental Lab				
Delta-BHC	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Dieldrin	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Endosulfan I	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Endosulfan II	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Endosulfan Sulfate	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Endrin	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Endrin Aldehyde	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Endrin Ketone	EPA 8081B	CalScience Environmental Lab				
Gamma-BHC	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Heptachlor	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Heptachlor Epoxide	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25

Table F–2 (continued). Quality Control Limits for Groundwater Monitoring Parameters DOE LEHR

Parameter	Method Reference	Laboratory	MS CL	MS RPD	LCS CL	LCS RPD
Methoxychlor	EPA 8081B	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Toxaphene	EPA 8081B	CalScience Environmental Lab				
2,4,5,6-Tetrachloro-m-Xylene	EPA 8081B	CalScience Environmental Lab	50–135		50–135	
Decachlorobiphenyl	EPA 8081B	CalScience Environmental Lab	50–135		50–135	
Aroclor-1016	EPA 8082	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Aroclor-1221	EPA 8082	CalScience Environmental Lab				
Aroclor-1232	EPA 8082	CalScience Environmental Lab				
Aroclor-1242	EPA 8082	CalScience Environmental Lab				
Aroclor-1248	EPA 8082	CalScience Environmental Lab				
Aroclor-1254	EPA 8082	CalScience Environmental Lab				
Aroclor-1260	EPA 8082	CalScience Environmental Lab	50–135	0–25	50–135	0–25
Aroclor-1262	EPA 8082	CalScience Environmental Lab				
2,4,5,6-Tetrachloro-m-Xylene	EPA 8082	CalScience Environmental Lab	50–135		50–135	
Decachlorobiphenyl	EPA 8082	CalScience Environmental Lab	50–135		50–135	

Abbreviations:

MS matrix spike
CL control limit
RPD relative percent difference
LCS laboratory control sample
EPA Environmental Protection Agency

Appendix G

Laboratory Quality Assurance Documentation

This appendix contains Proprietary Information that can only be released with concurrence of the owner.

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Appendix H

Construction Quality Assurance Plan

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Construction Quality Assurance Plan

1.1 Introduction

This Construction Quality Assurance Plan supports the implementation of remedial activities at LEHR covered by the Remedial Design/Remedial Action Work Plan for the Former Laboratory for Energy-Related Health Research Federal Facility University of California, Davis. This plan is consistent with and supplements the requirements of the Quality Assurance Project Plan and quality assurance elements covered in Section 7 of the Remedial Design/Remedial Action Work Plan.

1.2 Distribution

This plan shall be distributed with the Remedial Design/Remedial Action Work Plan to all signatories of the ROD and those on the distribution list for the QAPP. The EH&S Unit at UC Davis shall provide this plan to all entities who conduct work subject to the Remedial Design/Remedial Action Work Plan.

1.3 Scope

This plan applies to all construction activities subject to the Remedial Design/Remedial Action Work Plan. These activities include installation of groundwater monitoring wells, installation of land monuments, and miscellaneous construction activities associated with the implementation of remedial actions subject to the Remedial Design /Remedial Action Work Plan.

1.4 Project Information

Site description information, site history and the purpose of remedial activities subject to this plan are described in Section 1 of the Remedial Design/Remedial Action Work Plan.

1.5 Quality Management Organizational Structure

The roles and responsibilities of project personnel are described in Section 2.1 of the QAPP. The installation of monitoring wells, fencing, and other structures at LEHR will be conducted by contractor personnel who will report to the Project Manager under a contract for the specific work to be conducted.

Project personnel may delegate the execution of, but not the responsibility for, their quality-affecting tasks to other qualified project personnel at any time. However, key project personnel may also delegate a substantial subset of their functions to a qualified deputy, who will assume full responsibility for the delegated duties. In either case, delegated duties and responsibilities shall be clearly defined, and documented in writing.

1.6 Qualifications

The Project Manager will ensure that all personnel who conduct work subject to the Remedial Design/Remedial Action Work Plan have appropriate qualification as required by Section 5 of the QAPP.

Personnel assigned to perform, review, approve, and/or certify the design of architectural, structural, mechanical, electrical, civil, or other engineering features of the work should be registered to practice in their particular professional field in the State of California.

1.7 Instructions and Procedures

Project design calculations and drawings will be developed, reviewed, documented, and filed in accordance with Section 10 of the QAPP. The PM will be primarily responsible for the implementation of design control requirements.

Inspections and observations will be used to ensure that the remediation activities and other associated work meet or exceed the project requirements, including any associated design criteria, plans, and specifications.

At the completion of certain work elements, the PQAS will conduct a completion inspection and develop a "punch list" of items that do not conform to the approved plans and specifications. A target date to complete punch list items will be established, and a subsequent completion inspection will be conducted. Deficiency correction dates will be consistent with the construction schedule.

1.8 Well Installation

New wells will be installed in hydrostratigraphic unit (HSU)-1 for groundwater monitoring purposes using a hollow-stem auger drill rig to advance an eight-inch-diameter borehole for a two-inch diameter well to approximately 75 feet below ground surface. Soil samples from well borings will be collected and logged according to Standard Operating Procedure (SOP) 3.2, "Subsurface Soil Sampling While Drilling," and SOP 15.1, "Lithologic Logging." The soil sample frequency will be not less than one sample per five feet of borehole from the surface to 45 feet below ground surface (ft bgs), with continuous soil core collected below 45 ft bgs. Soil cuttings and core generated during drilling activities shall be managed in accordance with the Soil Management Plan provided in Appendix A.

Wells will be installed in accordance with SOP 8.1, "Monitoring Well Installation," as shown in Figure H–1 and Figure H–2. Volumes of grout, bentonite, and filter pack will be calculated based on borehole and well casing diameters. The monitoring wells will be designed and installed under the supervision of an experienced geologist, working under the supervision of a California-certified professional geologist. To be consistent with previous wells, the HSU-1 wells will be constructed with threaded two-inch diameter schedule-40 polyvinyl chloride (PVC) casings with screen intervals that are 15 feet long. Assuming typical HSU-1 soil types are present, the wells will be constructed using 0.01-inch-slot PVC screen with a fine-grained sand pack. Soil core from the planned screened interval will be evaluated, however, and well construction will be modified, if needed, according to the procedure outlined in SOP 16.1, "Filter Pack and Well Screen Slot Size Determination."

Although the exact construction details will be based on the lithologic logging during drilling, the HSU-1 screened intervals are expected to extend from approximately 55 to 70 feet below ground surface. If the borehole is over-drilled, it will be grouted and plugged with bentonite to a depth corresponding to the depth of the well. The annular space will be filled with sand filter pack to two feet above the screened interval; a seal, at least three feet thick, consisting of hydrated bentonite chips, will be placed above the filter pack; and a primary sanitary seal of neat Portland cement will be placed above the bentonite-chip seal, to reach the surface. In addition to the steps outlined in SOP 8.1, the bentonite chips will be hydrated by adding water after each four-inch thick lift is placed to ensure hydration, unless the seal is definitely within the saturated zone. The wells will be completed with a locking well cap, and either a traffic-rated flush-mount vault (Figure H–1) or a locking steel stove pipe (Figure H–2) with or without protective bollards (shown on Figure H–2), depending on the location.

1.8.1 Well Development

A minimum of 24 hours will elapse between completing the wells and beginning well development activities, to allow concrete and grout to attain sufficient strength. Well development activities will be performed at the discretion of the field geologist and hydrogeologist.

Well development will be considered complete when the water is free of sediment; when specific conductance (SC), pH, and temperature are within the stabilization goals for three consecutive readings; and when at least three times the water volume calculated to be in the well casing at the start of development has been removed. The stabilization goals are:

- Conductance: ± 10 percent.
- pH: ± 0.2.
- Temperature: ± 0.3 degrees Celsius.
- Turbidity: less than 10 nephelometric turbidity units (NTUs).

If the SC, pH, and temperature do not stabilize, or the turbidity is not reduced below 10 NTUs due to low recharge, well development will be considered complete when a minimum of three well casing volumes are removed and development has proceeded for at least four hours. Well development purge water and decontamination water will be discharged to the campus wastewater treatment plant.

1.8.2 Postings

Each monitoring well shall be marked with a plaque or tag (Figure H–3) that contains a discrete identifier (CERCLA Groundwater Monitoring Well No. UCDX-XXX). The plaque or tag shall state that destructing or tampering with the well without approval from agencies who are signatories to the ROD is prohibited.

1.9 Construction Quality Control Testing and Reporting

Quality control tests and checks will be performed per SQP 7.1.

10.0 Inspections and Reviews

Newly installed wells will be inspected by a competent person qualified to perform such inspection at the completion of the installation or the county inspector prior to well operation.

1.11 Sampling Requirements

Sample collection must conform to Sampling and Analysis Plans required by Section 3.2.4 of the QAPP. The SAP for groundwater sample collection required by the Remedial Action/Remedial Action Work Plan is defined in Section 3 of the Remedial Design/Remedial Action Work Plan. The quality assurance aspects of the sample collection, such as DQOs, are discussed in Section 7 of the Remedial Design/Remedial Action Work Plan. Sampling procedures in Appendix E apply to the sample collection activities.

1.12 Change Control

Changes to scope, schedule and cost will be documented in field work variances, as specified in Section 18 of the QAPP and SQP 11.1, "Field Work Variance." Field work variances will be documented and tracked by the SC, and reviewed and approved by the PM. The PHSM and/or the PQAM will be consulted on any changes that have the potential to affect H&S and/or quality.

1.13 Noncompliance and Corrective Action

Noncompliances and deficiencies associated with installed equipment, construction elements, samples, or data may be found during the normal course of activities and during inspections. Nonconformance Reports (NCRs) discussed in Section 16 of the QAPP will be employed to ensure continuous improvement of items and work processes. A NCR will be generated when a deficiency is encountered during a specific project task which cannot be immediately corrected during the operations, or which is of a repetitive nature. The processing of nonconformances will be implemented in accordance with SQP 10.1 "Nonconformance Control."

A nonconformance is defined as a deficiency or deviation in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. The originator of a NCR will describe the nonconformance and the requirements deviated from on the form provided for that purpose and will notify the Project Quality Assurance Manager.

1.14 Documentation and Recordkeeping

Prior to issuance for use, all construction documents will be formally reviewed and approved. This review will cover administrative as well as technical and quality issues. Approval will be denoted by a signature and date page in each document, which will include the PM and PQAM, as a minimum.

Quality records are those documents which provide direct documentary evidence of the quality of items, activities, services, and compliance with the contract or regulatory requirements, and which have been completed and submitted for acceptance and retention.

Administrative records are those documents which do not directly provide documentary evidence of the quality of items, activities, or compliance with the contract or regulatory requirements.

All quality-affecting records generated during the construction activities will be managed in accordance with Sections 4 and 8.2 of the QAPP; SQP 4.1, "Document Control"; and SQP 4.2, "Records Management." Quality-affecting documents include, but are not limited to, personal field logs, calibration records, monitoring data, inspection checklists, sampling documentation, and procurement records.

All records generated by project personnel must be complete, legible, and written in ink. Corrections must be made with a single line, and documented with the initials of the person making the correction and the date the correction was made.

Field documentation will be collected and compiled on a daily basis by the SC or designee.

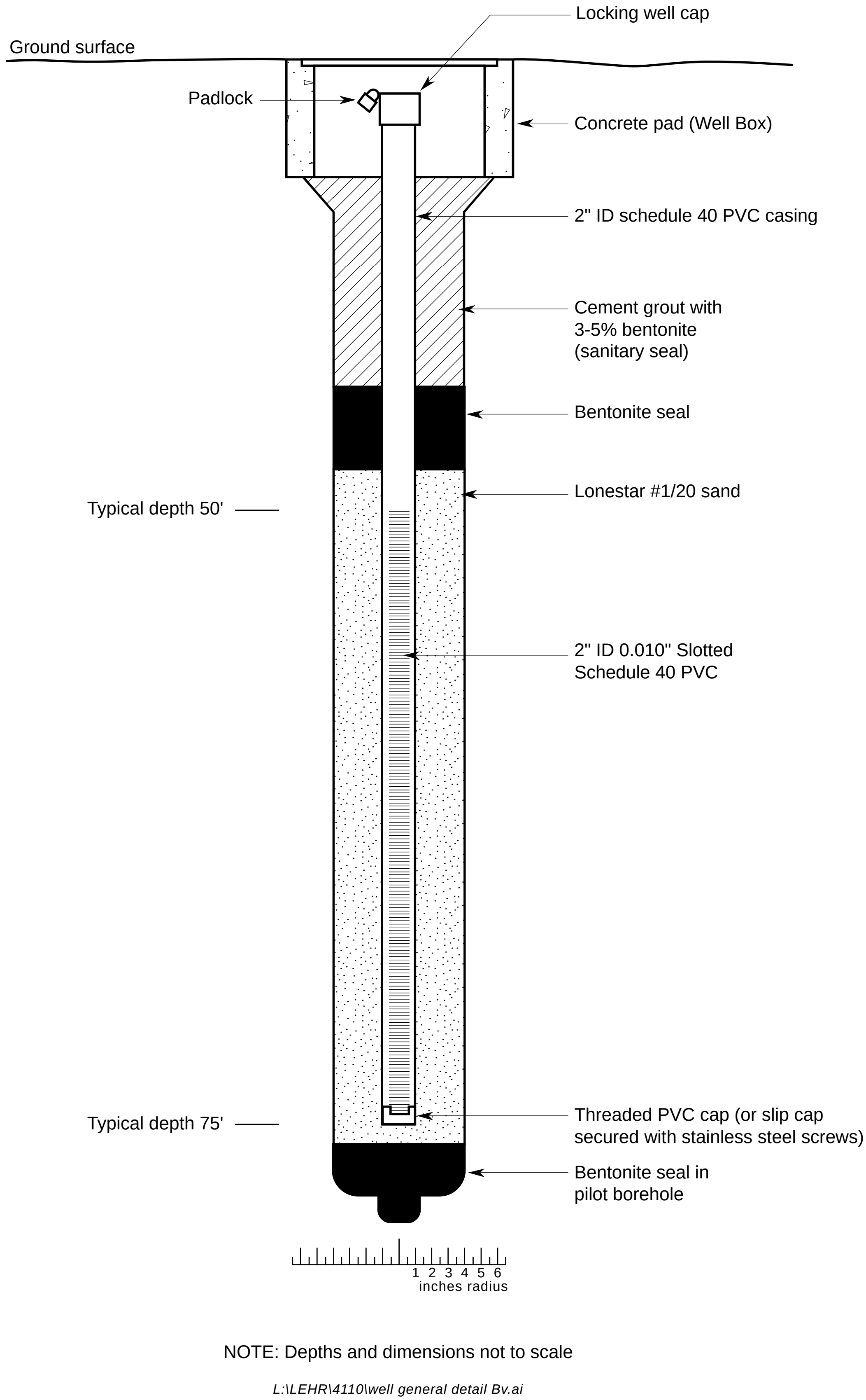
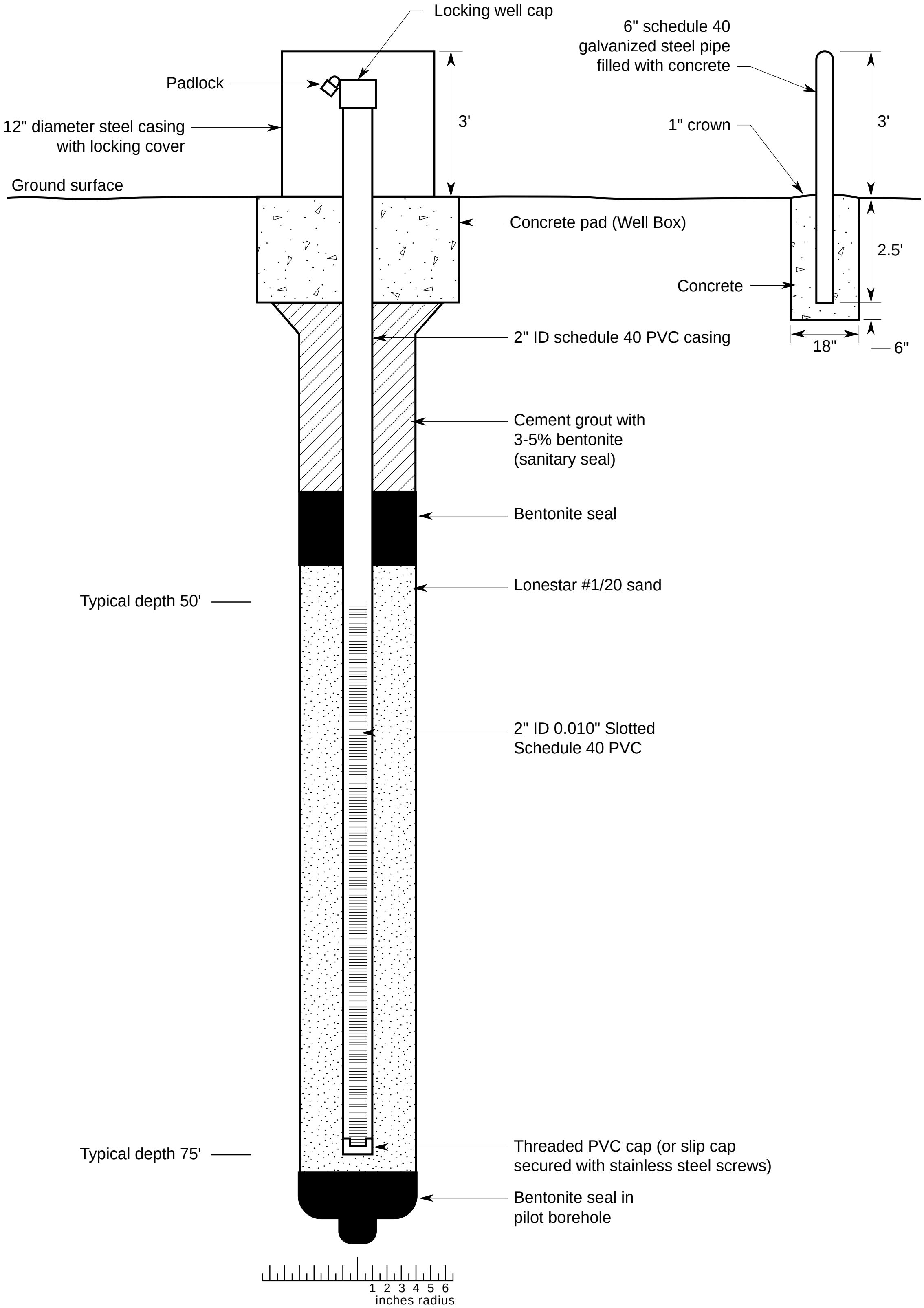


Figure H–1. Typical Installation Drawing—Well with Flush-Mounted Vault



NOTE: Depths and dimensions not to scale

L:\LEHR\4110\well general detail A.ai

Figure H–2. Typical Installation Drawing—Well with Locking Steel Stove Pipe

CERCLA Groundwater Monitoring
Well No. UCDX-XXX

Destruction of or tampering with this well is prohibited. Call (530) xxx-xxxx for information. Operated for the United States Department of Energy.

Dimensions: 3-inch wide × 2-inch high plaque
Material: Stainless Steel or Aluminum plaque with stamped lettering.
Text Font: Arial

Figure H–3. Typical Installation Drawing—Well Plaque or Sign

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Appendix I

Standard Operating Procedures and Standard Quality Procedures

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U.S. Department of Energy

Oakland Operations Office, Oakland, California

FINAL STANDARD OPERATING PROCEDURES

for the:

Environmental Restoration/Waste Management
Laboratory for Energy-Related Health Research (LEHR)
University of California at Davis, California

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 95612-5208

Prepared by:

Weiss Associates
5801 Christie Avenue, Suite 600
Emeryville, CA 94608-1827

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental and Geologic Services

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Issued To: ____________________ Date: ______________

Copy No.: ________ ■ Controlled ☐ Uncontrolled

Approvals Page

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Emeryville, CA 94608-1827

October, 2010

Approved by: ________________________ Date: ____________________
Mary Stallard, R.G.
Project Quality Assurance Manager
Weiss Associates

Approved by: ________________________ Date: ____________________
Robert O. Devany, R.G., C.H.G.
Project Manager
Weiss Associates

Approved by: ________________________ Date: ____________________
Michael D. Dresen, R.G., C.H.G.
Program Manager
Weiss Associates

TABLE OF CONTENTS AND LOG OF REVISIONS

STANDARD OPERATING PROCEDURES

FORMS AND FIGURES FOR STANDARD OPERATING PROCEDURES

Note: SOPs and associated forms may be revised, added, or deleted in accordance with the provisions of the Quality Assurance Project Plan. SOPs and associated forms are not numbered sequentially. Therefore, a missing number in the above list does not signify that a SOP or associated form is missing.

SOPs annotated "*[see RPP]*" are not included in this volume, but are included in a separate volume with the Radiological Protection Program (RPP).

CHAIN-OF-CUSTODY

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the method and responsibilities associated with the maintenance and custody of samples which are to be used to provide data which form a basis for making project related decisions. It outlines the general procedures for maintaining and documenting sample chain of custody from the time of sample collection through sample disposition. This SOP also applies to bioassay samples collected and handled in accordance with Health and Safety Procedure (HSP) 16.1, Internal Dosimetry Monitoring.

2.0 REFERENCES

2.1 Quality Assurance Project Plan

2.2 SQP 4.2 - Records Management

2.3 HSP 16.1 – Internal Dosimetry Monitoring

3.0 DEFINITIONS

3.1 Chain-of-Custody

The Chain-of-Custody (COC) document is the written record that traces the sample possession from the time each sample is collected until its final disposition, sometimes called the "cradle to grave" record. Chain-of-Custody is maintained by compliance with one of the following criteria:

- The sample is in the individual's physical possession;
- The sample is maintained in the individual's physical view after being in his/her possession;
- The sample is transferred to a designated secure area restricted to authorized personnel; and,
- The sample is sealed and maintained under lock and key to prevent tampering, after having been in physical possession.

3.2 Waybill

A document that contains a list of the goods and shipping instructions relative to a shipment.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Project Manager is responsible for assuring proper COC is initiated at the time the sample(s) are collected and maintained throughout the handling and subsequent transportation of the sample(s) to the designated laboratory. Additionally, the Project Manager is the project authority for determining the disposition and fate of sample(s) which have identified deficiencies (e.g., missed holding times, elevated temperature at receipt, etc.).

4.1.2 The sample team member(s) are responsible for properly documenting and maintaining the COC from the time of sample collection until the sample(s) are delivered to the lab.

4.1.3 Laboratory personnel are responsible for receipt and entry of samples into the laboratory which have been submitted under a COC document. Additionally, samples received will be entered into the laboratory COC procedures by properly documenting and maintaining COC from the moment that they take custody of the sample(s) at the laboratory until the sample(s) are disposed of or returned to the client.

4.2 General

4.2.1 An overriding consideration for data resulting from laboratory analyses is the ability to demonstrate that the samples were obtained from the locations stated and that they reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal must be documented to accomplish this. Documentation will be accomplished through a COC Record that lists each sample and the individuals performing the sample collection, shipment, and receipt.

4.2.2 The original COC document will accompany the samples while a copy will be retained in the project file.

4.3 Field Sample Custody

4.3.1 Sampling personnel, upon collection of samples for analysis, will properly complete a COC Record (Attachment 6.1). The COC document will be the controlling document to assure that sample handling and custody are maintained thereby assuring the sample(s) are representative of the environment from which they were collected. At a minimum, the following information will be recorded on the COC document:

- The unique identification number assigned to each sample;

- A physical description of the sample type (e.g., soil, water, etc.);
- The date and time of the sample collection;
- Container type (e.g., glass, poly, brass sleeve, etc.);
- Sample volume and number of containers (e.g., 2 x 40 ml, 3 x 1 liter);
- Sample preservation (e.g., HNO_3, H_2SO_4, 4^oC);
- Requested analyses;
- Special instructions to the laboratory including handling requirements, quality assurance/quality control, health and safety, and sample disposition;
- The project name and number;
- The date the analytical report is due;
- The names of all sampling personnel;
- The name and phone number of the project contact;
- The name and phone number of the laboratory contact; and,
- The name of the courier and the waybill number (if applicable).

4.3.2 The COC document will be initiated in the field by the person collecting the samples and signed by each individual who has the samples in their possession. Each time that sample custody is transferred, the former custodian must sign over the COC as Relinquished By, and the new custodian must sign on to the COC as Received By. Each signature must be accompanied by the date, time, and the name of their project or company affiliation.

4.3.3 Transferring of COC from sampling personnel to the analytical laboratory will be performed in accordance with the requirements stated below.

4.3.4 If the sampling personnel deliver the samples to the laboratory, transfer of COC occurs as follows:

- The sample custodian delivers the samples to the laboratory and relinquishes the samples directly to a laboratory representative. Any person involved in the collection of the samples may act as the sample custodian.
- The custodian signs the COC listing his/her name, affiliation, the date, and time.
- The laboratory representative must receive the samples by signing his/her name, affiliation, the date, and time on the COC. The laboratory representative may decline to take receipt of the samples if the COC is not properly completed or if the samples are not properly packaged. Any designated laboratory personnel may act as the sample custodian.
- One copy of the COC is given to the sample collector to be returned to the project files and one copy is maintained with the samples at the laboratory.

4.3.5 If the sampling personnel transfer sample(s) to the laboratory utilizing a common carrier, sampling personnel will retain COC responsibility and the common carrier is not responsible for maintaining sample custody. The sample collectors are responsible for packaging the samples in a manner that meets the COC definition criteria, that is, the samples are sealed to prevent tampering. When transferring samples to the courier for transport, COC procedures are maintained as follows:

- The sample collector lists the courier affiliation and waybill number on the COC.
- The sample collector relinquishes custody by signing his name, affiliation, date, and time. The collector keeps a copy of the relinquished COC for the project file.
- The relinquished original COC is sealed in a watertight plastic bag and taped to the inside of the lid of the container used for transportation.
- The transportation container is sealed to prevent tampering and given to the courier for delivery to the laboratory.
- The sample collector obtains a copy of the waybill from the courier for the project file.
- The laboratory representative must receive the samples by signing his/her name, affiliation, the date, and time on the COC. This copy is maintained with the samples at the laboratory.
- The laboratory representative obtains a copy of the waybill from the courier for the project file.

4.3.6 Sampling personnel should record field events on a "Field Activity Daily Log" (see Attachment 6.2) and/or a "Sample Collection Log" (see SOP 3.1) as may be necessary to document the field work.

4.4 Analytical Laboratory Custody

4.4.1 Upon receipt at the analytical laboratory, the field generated COC document will be signed and dated; the time, temperature and condition of the samples will be noted; and laboratory identification will be provided in the appropriate spaces.

4.4.2 Laboratory receipt personnel will enter the samples into the laboratory by implementing the sample custody procedures addressed within their LEHR approved QA Program.

4.4.3 After completion of analytical testing, sample remnants not consumed during testing may be kept for six months beyond the completion of analysis, unless otherwise specified by a notation on the COC that samples are to be returned to the project site for disposal. Once this time period has elapsed, the samples will be disposed of and the disposal record number will be recorded on the laboratory record copy of the COC.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Chain-of-Custody Record

6.2 Field Activity Daily Log

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

CHAIN-OF-CUSTODY RECORD

Chain-of-Custody Record L001

Please send analytical results and a copy
of the signed chain of custody form to:
____
Project ID:______________________

Lab Personnel: **PLEASE INCLUDE QA/QC DATA**
1) Specify analytical method and detection limit in report.
2) Notify us if there are any anomalous peaks in GC or other scans.
3) ANY QUESTIONS/CLARIFICATIONS:
CALL US.

Sampled by:________________________________

Laboratory Name:________________________

No. of Containers	Sample ID	Container Type[1]	Sample Date	Sample Time	Vol[2]	Fil[3]	Ref[4]	Preservative (specify)	Analyze for	Analytical Method	Turn[5]	COMMENTS

1.___________________________________
Released by (Signature), Date, Time
1.___________________________________
Affiliation
2.___________________________________
Received by (Signature), Date, Time
2.___________________________________
Affiliation

3.___________________________________
Released by (Signature), Date, Time
3.___________________________________
Affiliation
4.___________________________________
Shipping Carrier, Method, Date, Time
4.___________________________________
Affiliation

5.___________________________________
Released by (Signature), Date, Time
5.___________________________________
Affiliation
6.___________________________________
Received by Lab Personnel, Date, Time
6.___________________________________
Affiliation, Telephone

x.____________________________________
Seal Intact?

1 = Sample Type Codes: W=Water, S=Soil, Describe Other; Container Type Codes: V=VOA/Teflon Septa, P = Plastic, C or B = Clear/Brown Glass, Describe Other;
2 = Volume per container; 3 = Filtered (Y/N); 4=Refrigerated (Y/N)
5 = Turnaround [N=Normal, W=1 Week, R=24 Hour, HOLD (write out)]

ATTACHMENT 6.2

FIELD ACTIVITY DAILY LOG

Field Activity Daily Log

Page__of__

Project Name____

Vehicle(Field Use):

Project # ___________ Project Manager ________________ WA ________ Odometer in ________

Name ____ Personal ____ Odometer out _______

Billing Period ________________ Total Hrs. Billed ______ Rental ______ Mileage ____________

Requested Work Summary

Extra Scope of Work (ESOW) Summary

Activity Code	Hours Billed	Activity Code	Hours Billed	Activity Code	Hours Billed
[__________]	[__________]	[__________]	[__________]	[__________]	[__________]

Date/ Time	Activity Description	Activity Code	Hours	ESOW

SAMPLE HANDLING, PACKAGING AND SHIPPING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) outlines the methods and responsibilities for field personnel to use in the packaging and shipping of environmental samples, including hazardous, low-level radioactive, and mixed waste samples, for chemical and physical analysis. This SOP only applies to the packaging and shipping of limited quantity, environmental samples. The details in this SOP are only applicable to the general requirements for sample packaging and shipping and should only be used as a guide for developing more job-specific work plans. This SOP also applies to bioassay samples collected and handled in accordance with Health and Safety Procedure (HSP) 16.1 – Internal Dosimetry Monitoring.

2.0 REFERENCES

2.1 *EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14*

2.2 *EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.3 *Code of Federal Regulations, DOT 49 CFR Parts 100 to 177*

2.4 *Dangerous Goods Regulations, IATA, January 1, 1994*

2.5 *SQP 4.2 - Records Management*

2.6 *HSP 16.1 – Internal Dosimetry Monitoring*

3.0 DEFINITIONS

3.1 Environmental Sample

A limited quantity sample of soil, water, air, or other substance found in the environment collected specifically for chemical or physical analysis.

3.2 Hazardous Material

Hazardous material means a substance or material, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. For the LEHR site, the term includes hazardous substances and hazardous wastes, materials designated as hazardous under the provisions of 49 CFR Sec. 172.101, and materials that meet the defining criteria for hazard classes and divisions in 49 CFR part 173.

3.3 Hazardous Substance

Hazardous substance for the purposes of this SOP, means a material, including its mixtures and solutions, that:

- Is listed in Appendix A to 49 CFR Sec. 172.101;
- Is in a quantity, in one package, which equals or exceeds the reportable quantity (RQ) listed in Appendix A to 49 CFR Sec. 172.101; and
- When in a mixture or solution:
  - For radionuclides, conforms to paragraph 6 of Appendix A to Sec. 172.101.
  - For other than radionuclides, is in a concentration by weight which equals or exceeds the concentration corresponding to the RQ of the material, as described in 49 CFR Sec. 173.133.

3.4 Hazardous Waste

Any substance listed in 40 CFR Subpart D (260.30 et seq.) or otherwise characterized as ignitable, corrosive, reactive, or toxic as specified in Subpart C (261.20 et seq.) that would be subject to manifest and packaging requirements specified in 40 CFR 262. Hazardous waste is defined and regulated by the U.S. Environmental Protection Agency (EPA).

3.5 Sample

Physical evidence collected from a facility or the environment which is representative of conditions at the point and time at which the sample is collected.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 Compliance with this procedure is the responsibility of project management, site management, health and safety, and field personnel.

4.1.2 The Project Manager (PM) is responsible for the development and review of site-specific work plans which address the specific sample handling, packaging, and shipping requirements for the project. The PM should review the project-specific documentation forms to ensure they are appropriate for the field activities. The PM is also responsible for seeing that field personnel receive proper training and maintain quality assurance/quality control (QA/QC).

4.1.3 The Project Quality Assurance Specialist (PQAS) is responsible for the periodic review of documentation generated during sample handling, packaging, and shipping and the periodic review and audit of field personnel as they perform the work. If problems arise, the PQAS is also responsible for swift implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to requirements, issuing nonconformances).

4.1.4 The Site Health and Safety Officer (SHSO) is responsible for ensuring complete compliance with the Health and Safety Plan by all personnel on site. He/She is responsible for ensuring that all protective measures are identified and implemented to adequately protect site workers.

4.1.5 The Radiological Control Technician (RCT) is responsible for assisting the SHSO in the performance of monitoring, posting and evaluation of work-site safety and radiological controls conditions.

4.1.6 The Sample Manager (SM) is responsible for the proper implementation of the sampling plan and to ensure that all sample collection activities are conducted in accordance with this SOP.

4.1.7 The LEHR Project Chemist or designee is responsible for coordinating with the analytical laboratory and to ensure that all analytical activities are conducted in accordance with the sampling and analysis plan.

4.2 Sample Handling

4.2.1 Inspect the sampling containers to ensure that they are appropriate for the samples being collected, correctly preserved, and undamaged.

4.2.2 When collecting a sample, always use approved/site specific personal protective equipment (e.g., gloves, etc.) to prevent cross-contamination from sample to sample but also as a health and safety requirement.

4.3 Field Packaging

4.3.1 Collect the samples in accordance with the site-specific sampling plans and applicable SOPs.

4.3.2 As soon as possible after sample collection, tightly seal the container. Custody seals may be used for additional sample security. The custody seal should be placed over the cap so that any attempt to remove the cap will cause the seal to be broken. Do not place custody seal over a volatile organic analysis (VOA) vial septum.

4.3.3 Place all containers in separate, appropriately sized, airtight, seam sealing polyethylene bags (e.g., Ziploc™). Seal the bag, removing any excess air.

4.3.4 Place the bagged container inside an insulating shipping container, "cooler." This cooler should have frozen blue ice inside to assure samples remain cool, "4°C," during transit from field to the packaging location.

4.3.5 Maintain the samples under chain-of-custody (COC) (SOP 1.1) in accordance with the site-specific work plans and appropriate SOPs.

4.4 Sample Packaging

4.4.1 Ensure that packages meet applicable requirements of Reference 2.3.

4.4.2 Inspect the integrity of the shipping container. The container is generally a "cooler" constructed of heavy plastic or metal with appropriate insulating properties so that variations in temperature during shipping are minimized. Also, make sure that the drain plug has been sealed.

4.4.3 Place two or more inches of absorbent packaging material (e.g., Vermiculite™) in the bottom of the shipping container. There should be sufficient absorbent material to absorb two times the volume of liquid, if liquid is present.

4.4.4 Carefully check the COC record against the collected sample labels and containers to ensure that the sample numbers, sample description, date and time of collection, container type and volume, preservative, and the required analytical methods are correct and in agreement.

When shipping potentially radioactive samples:

- Place samples within an inner container (a clear plastic bag or other transparent packaging);
- Seal the inner-container;
- Label the container “Radioactive”;
- Include a copy of the LEHR limited quantity statement. This statement includes the sentence “This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive materials, exempted package—limited quantity of material, UN2910.”

4.4.5 Place the samples in the shipping container, allowing sufficient room between the samples to place ice and/or packing material.

4.4.6 Double bag and seal crushed or cubed ice in heavy-duty polyethylene bags. Place these bags of ice on top of and between samples. Blue ice should only be used along with crushed/cubed ice; it does not maintain the 4°C temperature necessary for regulatory compliance. The remaining space will be filled with packing material. Place temperature blank between ice and inner-package.

4.4.7 All samples requiring 4°C temperature preservation will be acceptable "as in" within the range of 4°C ± 2°C. The laboratory should record the temperature of receipt on the COC. For all samples received from 6°C to 10°C, the sample(s) and temperature (in 1°C increments) will be noted on the COC and then analyzed. Samples with temperatures greater than 10°C and VOA samples below 0°C will be reported immediately to the Project Manager.

4.5 Sample Shipping

4.5.1 Shipping shall meet all applicable requirements of References 2.3 and 2.4.

4.5.2 All materials being offered for transportation shall be properly classified based on existing data, site history, chemical characteristics, and radiological characteristics, etc. This is necessary in order to ensure that all appropriate packaging, marking, labeling, handling, placarding, shipping papers, and mode of transportation are utilized as applicable/required.

4.5.3 Samples that contain or could potentially contain radioactive material shall only be sent to laboratories with an appropriate NRC or Agreement State Radioactive Materials License. Prior to shipment of radioactive material, it should be verified that the laboratory/facility is able to receive/possess the nuclides and total activity present in the shipment.

4.5.4 As applicable, all radiological surveys mandated by Reference 2.3 shall be performed for packages and conveyances for shipping and receipt of radioactive material.

4.5.5 The person in charge of sample custody will time, date, and sign over relinquishment of custody on the COC. When a common carrier is to be used for sample shipment, also record the air/waybill number (tracking number) and the name of the carrier on the COC record. Place the original copy of the COC record in a sealed, clear plastic envelope or bag and tape the COC record envelope to the inside lid of the shipping container. Retain a copy of the COC record for tracking purposes.

4.5.6 Using nylon reinforced strapping tape or mailing tape, bind the shipping container. Using duct tape, seal all potential leak points including any drainspout.

4.5.7 Place custody tape (see Attachment 6.1) over opposite ends of the lid.

4.5.8 Mark the container "THIS END UP," or apply arrow labels that indicate the proper position to be maintained during shipping.

4.5.9 Apply a label stating the name and address of the shipper and the receiving laboratory on the outside of the cooler.

4.5.10 Turn the sample(s) over to the courier or carrier for delivery to the laboratory. All samples should be shipped by the fastest available method to the laboratory as soon as possible after sample collection.

NOTE: The courier or carrier is not responsible for sample custody and is not required to sign the COC.

4.5.11 Contact the appropriate laboratory personnel to advise them of the sample shipment. In addition, fax a copy of the COC to the laboratory and the LEHR Project Chemist.

4.5.12 Review the COC and sample collection forms for completeness and turn them over to site or project management personnel.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

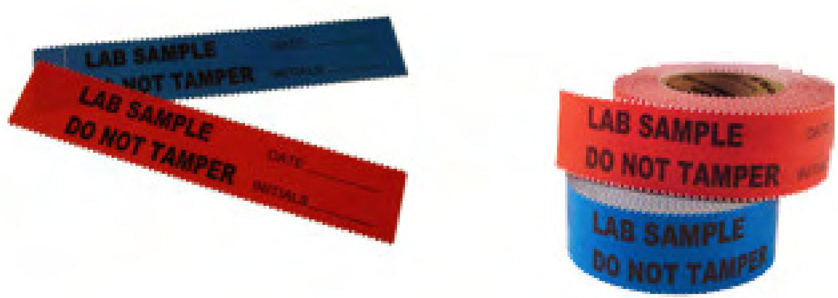
6.0 ATTACHMENTS

6.1 Typical Custody Tape

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

TYPICAL CUSTODY TAPE


LAB SAMPLE
DO NOT TAMPER
DATE
INITIALS
LAB SAMPLE
DO NOT TAMPER
LAB SAMPLE
DO NOT TAMPER

SURFACE AND SHALLOW SUBSURFACE SOIL SAMPLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This standard operating procedure (SOP) establishes guidelines and procedures for the collection of surface (zero to six inches below ground surface) and shallow subsurface (six inches to six feet below ground surface) soil samples for physical and chemical analyses. Proper collection procedures are necessary to assure the quality and integrity of all surface and shallow subsurface soil samples. Additional procedures and requirements will be provided in the task-specific sampling or work plans, as necessary.

2.0 REFERENCES

2.1 *Environmental Protection Agency (EPA), September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14*

2.2 *EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.3 *SOP 1.1 - Chain-of-Custody*

2.4 *SOP 2.1 - Sample Handling, Packaging and Shipping*

2.5 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.6 *SOP 17.1 - Sample Labeling*

2.7 *SOP 17.2 - Sample Numbering*

2.8 *Standard Quality Procedure (SQP) 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Surface Soil Sample

Soil collected from the surface to a depth not exceeding six inches.

3.2 Shallow Subsurface Soil Sample

Soil collected at a depth between six inches and six feet.

3.3 Subsurface Soil Sample

Soil collected at any depth greater than six inches.

3.4 Disturbed Soil Sample

A disturbed soil sample is a soil sample whose *in situ* physical structure and fabric has been disturbed as the direct result of sample collection.

3.5 Undisturbed Soil Sample

An undisturbed soil sample is a soil sample whose *in situ* physical structure and fabric has not been disturbed as the result of sample collection.

3.6 Grab Sample

A grab sample is a representative disturbed soil sample that is collected with devices such as shovels, stainless steel spoons, etc.

4.0 PROCEDURE

This section contains both the responsibilities and procedures involved with surface and shallow subsurface soil sampling. Proper surface and shallow subsurface soil sampling procedures are necessary to ensure the quality and integrity of the samples. The details within this SOP should be used in conjunction with task-specific sampling or work plans, which will generally provide the following information:

- Sample collection objectives;
- Locations and depths of soil samples to be collected;
- Numbers and volumes of soil samples to be collected;
- Types of analyses to be conducted for the samples;

- Specific quality control procedures and sampling required; and,
- Any additional surface or shallow subsurface soil sampling requirements or procedures beyond those covered in this SOP, as necessary.

At a minimum, the procedures outlined below for surface and shallow subsurface soil sampling will be followed.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control.

4.1.2 The Project Quality Assurance Specialist (PQAS) is responsible for periodically reviewing field-generated documentation associated with this SOP.

4.1.3 Field personnel assigned to surface and shallow subsurface soil sampling are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Site Coordinator or the PQAS.

4.2 Surface Soil Sampling Equipment

4.2.1 A number of devices can be used to collect surface soil samples. These include, but are not limited to: core samplers, hand augers, spoons, scoops, trowels, shovels, triers, etc. These devices are constructed of a number of materials including, but not limited to: stainless steel, brass, glass, Teflon®, etc.

4.2.2 The sampling and analytical requirements, as well as site characteristics, must be taken into account when determining the proper surface soil sampling equipment to use.

4.2.3 At present, the core sampling method is most commonly used for collecting both disturbed and undisturbed surface and shallow subsurface samples. The core sampler is typically a hollow cylinder, tapered at the leading end. A sample sleeve (brass, stainless steel, Lexan®, etc.) is inserted into the trailing end. The trailing end is then connected to a piston-type drive hammer. The core is driven into the soil by the hammer so that a relatively undisturbed sample is collected in the sleeve. The sample is then handled and shipped in the sample sleeve.

4.2.4 When core sampling is not feasible, a sample can be collected by using such devices as a shovel, hand auger, trowel, or stainless steel spoon, etc. The soil is transferred from the collection device into decontaminated sample containers (commonly glass jars). The task-specific sampling or work plans will specify the type of sampling equipment to be used. The required sample containers will also be specified in the task-specific sampling or work plans.

4.3 Surface Soil Sample Collection

4.3.1 Prior to sampling and between sampling locations, decontaminate the sample equipment according to SOP 6.1 and the procedures outlined in the task-specific sampling or work plans.

4.3.2 Ensure that all surface and shallow subsurface soil sampling locations have been appropriately cleared of all underground utilities and buried objects per the task-specific sampling or work plans. Review all forms and diagrams documenting the proposed sampling locations, as well as the locations of any underground utilities or buried objects.

4.3.3 As required, calibrate any health and safety monitoring equipment according to the instrument manufacturer's specifications. Calibration results will be recorded on the appropriate form(s), as specified in the task-specific sampling or work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

4.3.4 Don appropriate personal protective equipment as specified in the task-specific sampling or work plans.

4.3.5 Clear the area to be sampled of surface debris and vegetation using equipment that will not be used for sample collection.

4.3.6 If using the coring device, place the sleeve into the device and drive the assembly into the soil using the drive hammer. Drive the device into the soil until the trailing end of the sleeve is at the soil surface.

4.3.7 Retrieve the device. Verify that the soil recovery is adequate in the sample sleeve. If there is sufficient recovery, annotate the leading end of the sample sleeve.

4.3.8 If using a different sample collection device other than the coring device, scoop or collect soil and directly transfer the soil into the sample container (e.g., glass jar, brass sample sleeve, etc.). Fill the sample container until no head space exists.

4.3.9 If using sample sleeves, place Teflon® tape over each end of the sleeve and seal each end with plastic end caps. Custody seal may be used for additional sample security.

4.3.10 If using glass jars, cap or seal the jars appropriately. Custody seals should be used to provide additional sample security.

4.3.11 If using a sample kit for EPA Method 5035 (volatile organic compound analysis), the soil samples will be collected and preserved in the field following the procedures of EPA Method 5035. All sample collection equipment and containers will be provided in a O2SI Sample Aide kit or equivalent. Each kit contains the following items:

- One “T” handle syringe for collecting a soil sample;

- Two pre-weighed low-level volatile organic analysis (VOA) vials containing five milliliters of 20 % bisulfate solution;
- One pre-weighed high-level VOA vial;
- One pre-weighed evaporative loss VOA vial; and,
- One Teflon® tube of methanol preservative.

Additional field supplies/equipment may include the following:

- Scale for weighing the amount of soil collected;
- Scissors for cutting the Teflon® tube containing the methanol;
- Clean cloths or towels for wiping surfaces; and,
- Blade or knife for removing additional soil from the syringe.

Instructions for using the kit are as follows:

1. Using the "T" handle syringe, collect soil inside the syringe up to the bottom of the plunger, which is equivalent to approximately five grams of soil;
2. Remove the caps from all four vials;
3. Using the syringe, place an equal amount of soil (five grams) into each vial. Wipe the exterior of the syringe after each use with a clean cloth or towel;
4. Cut the Teflon® tube and pour methanol into the high level vial;
5. Brush any soil off the vial threads with a clean towel or cloth and tightly cap all vials;
6. Complete the information on the label provided;
7. Wrap the VOA vial rack in bubble wrap; and,
8. Place the VOA vial rack upright in a cooler for shipment to the analytical laboratory.

4.3.12 Appropriately label and number the sample containers per SOPs 17.1 and 17.2, respectively, and the task-specific sampling or work plans. The label will be completed with waterproof ink and will contain, at a minimum, the following information:

- Project number;
- Sample number;
- Sample location;

- Sample depth;
- Sample type;
- Date and time of collection;
- Parameters for analysis; and,
- Sampler's initials.

4.3.13 Document the sampling event on the Sample Collection Log (Attachment 7.1) or an equivalent form as specified in the task-specific sampling or work plans. Note any pertinent field observations, conditions or problems on the Field Activity Daily Log (SOP 1.1, Attachment 6.2). Any problems or unusual conditions should be immediately brought to the attention of the Site Coordinator.

4.3.14 Appropriately preserve, handle, package, and ship the samples per SOP 2.1 and the task-specific sampling or work plans. The samples shall also be managed per SOP 1.1.

4.3.15 Fill and abandon the sample hole as required by the task-specific sampling or work plans.

4.4 Shallow Subsurface Soil Sampling

4.4.1 The common method to collect shallow subsurface soil samples is to use a hand auger to bore to the desired sampling depth and then retrieve the sample with a core sampler. The hand auger might also be used to recover the sample for direct transfer into glass jars. The exact methodology should be specified in the task-specific sampling or work plans.

4.4.2 Successive drives of the core sampler may be used to recover shallow subsurface soil samples that are less than 18 inches deep. In all methods cited above, borehole stability should be maintained to prevent the recovery of slough in the samples. If sloughing cannot be controlled, then another sampling methodology may have to be considered.

4.4.3 As with surface soil samples, shallow subsurface soil sampling follows the same sample collection procedures specified in Section 4.3..

5.0 QUALITY CONTROL SOIL BLANK PREPARATION

One quality control soil blank will be sent with each shipment requiring analysis for volatile organic compounds. The soil blank will be prepared according to the following procedure:

5.1 Collect approximately eight ounces of soil from the container labeled "QC blank soil" located on the table in the on-site laboratory.

5.2 Lay the soil evenly over a one-foot by one-foot square of aluminum foil and place it under the heat lamps.

5.3 Adjust the lamps so that the soil temperature stabilizes at approximately 115 degrees (°) Celsius (C), ±15° (240° Fahrenheit [F], ±30°).

5.4 Shut the lamps off and measure the temperature of the soil with the digital thermometer after temperature stabilization. Record the temperature in a field notebook and turn the lamps back on.

5.5. Heat the soil for one hour.

5.6 After the one-hour period, shut the lamps off and measure the temperature again. If the second temperature measurement is above 100°C (212°F), then record the temperatures in a field notebook and proceed to Step 5.7. If the second measurement is below 100° C (212° F), then adjust the lamps to achieve a temperature greater than 100° C for one hour and measure the beginning and ending temperatures. Record the temperatures in a field notebook.

5.7 Allow the soil to cool below 50°C (122°F), then transfer sample to VOA vials using Method 5035 Sample Collection and Preservation Procedures in accordance with SOP 3.1, Surface and Shallow Subsurface Soil Sampling.

5.8 Assign the sample an identification number that is indistinguishable from the rest of the soil samples to be collected, so the blank will not be obvious to the laboratory.

5.9 Ship the soil blank with other soil samples on the same chain-of-custody form.

6.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

7.0 ATTACHMENT

7.1 Sample Collection Log

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 7.1

SAMPLE COLLECTION LOG

SAMPLE COLLECTION LOG

DATE	
TIME	
PAGE	OF
PROJECT NO.	

PROJECT NAME ______________________________

SAMPLE NO. ______________________________

SAMPLE LOCATION ______________________________

SAMPLE TYPE ____________________

COMPOSITE ________ YES ________ NO

COMPOSITE TYPE ____________________

DEPTH OF SAMPLE ____________________

WEATHER ____________________

CONTAINERS USED	VOLUME COLLECTED

COMMENTS:

PREPARED BY: ______________________________

SUBSURFACE SOIL SAMPLING WHILE DRILLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This standard operating procedure (SOP) establishes guidelines and procedures for subsurface soil sampling while drilling. Several methods may be used to collect subsurface samples. The more common drilling methods and sampling procedures are described below. Proper collection procedures are necessary to assure the quality and integrity of all subsurface soil samples. Additional specific procedures and requirements will be provided in the task-specific sampling or work plans, as necessary.

2.0 REFERENCES

2.1 *American Society for Testing Materials (ASTM), 1989, Standard Method for Penetration Test and Split-Barrel Sampling of Soils, Method D-1586-84, Philadelphia, PA*

2.2 *ASTM, 1986, Standard Practice for Thin-Walled Tube Sampling of Soils, Method D-1587-83, Philadelphia, PA, p. 304-307*

2.3 *ASTM, 1986, Standard Practice for Ring-Lined Barrel Sampling of Soils, Method D-3550-84, Philadelphia, PA, p. 560-563*

2.4 *SOP 1.1 - Chain-of-Custody*

2.5 *SOP 2.1 - Sample Handling, Packaging and Shipping*

2.6 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.7 *SOP 14.1 - Hollow Stem Auger Drilling*

2.8 *SOP 14.2 - Mud Rotary Drilling*

2.9 *SOP 14.3 - Air Rotary Drilling*

2.10 *SOP 14.4 - Dual Tube Percussion Drilling*

2.11 *SOP 15.1 - Lithologic Logging*

2.12 *SOP 17.1 - Sample Labeling*

2.13 *SOP 17.2 - Sample Numbering*

2.14 *SOP 19.1 - On-Site Sample Storage*

2.15 *Standard Quality Procedure (SQP) 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Borehole

A borehole is any hole drilled into the subsurface for the purpose of identifying lithology, collecting soil or water samples, and/or installing monitoring wells.

3.2 Split-Spoon Sampler

A split-spoon sampler is a steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. This device can be driven into resistant (semi-consolidated) materials using a drive weight or drilling jars mounted in the drilling rig. A standard split-spoon sampler (used for performing standard penetration tests) is 2 inches in outside diameter and 1.375 inches in inside diameter. This standard spoon typically is available in two common lengths, providing either 20-inch or 26-inch internal longitudinal clearance for obtaining 18-inch or 24-inch long samples, respectively. Six-inch long sleeves (tubes) of brass, stainless steel, or plastic are commonly placed inside the sampler to collect and retain soil samples. A five-foot long split-spoon sampler is also available. A California modified split-spoon sampler is also commonly used. The design is similar to the standard split-spoon except the outside diameter is 2.5 inches and the inside diameter is 2 inches.

3.3 Shelby Tube Sampler

A Shelby tube sampler is a thin-walled metal tube used to recover relatively undisturbed samples. These tubes are available in various sizes, ranging from 2 to 5 inches in outside diameter and 18 to 54 inches in length. A stationary piston device is included in the sampler to reduce sampling disturbance and increase sample recovery.

3.4 Drilling Jars

Drilling jars are a set of linked, heat-treated steel bars. The jars may be attached to a wireline sampling string incorporating a split spoon or other impact sampler. The jars are used to drive the sampler into the soil below the bottom of the borehole.

3.5 Direct-Push Continuous Core Sampler

Continuous core sampling system methods utilize a core barrel, which recovers a soil core from the interval through which the barrel is advanced. Soil samples are collected in 1.5-inch to 2.65-inch diameter brass or stainless steel sleeves inside the inner sample barrel. The sleeves are removed from the sample barrel and given to the site geologist or engineer for testing and lithologic description. The outer-drive barrel is recovered after the total depth of the boring is attained.

4.0 PROCEDURES

This section describes both the responsibilities and procedures involved with subsurface soil sampling while drilling. Proper subsurface soil sampling procedures are necessary to ensure the quality and integrity of the samples. This SOP should be used in conjunction with task-specific sampling or work plans, which will generally provide the following information:

- Sample collection objectives;
- Locations of soil borings and target horizons or depths of soil samples to be collected;
- Numbers and volumes of samples to be collected;
- Types of analyses to be conducted for the samples;
- Specific quality control procedures and sampling required; and,
- Any additional subsurface soil sampling requirements or procedures beyond those covered in this SOP, as necessary.

There are many different methods that may be used for subsurface soil sample collection during drilling. This SOP focuses on the two most common methods of soil sample collection: split-spoon sampling and direct-push continuous core sampling. At a minimum, the procedures outlined below for these two subsurface soil sampling methods will be followed. If other subsurface soil sampling methods are deemed necessary to meet project objectives, the procedures for these methods will be updated in this SOP or included in the task-specific sampling or work plans.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control.

4.1.2 The Project Quality Assurance Specialist (PQAS) is responsible for periodically reviewing field-generated documentation associated with this SOP.

4.1.3 Field personnel assigned to subsurface soil sampling during drilling are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Site Coordinator or the PQAS.

4.2 General Sampling Considerations

4.2.1 The two subsurface soil sampling methods covered in this SOP, split-spoon and Shelby tube, are commonly used in conjunction with hollow stem auger, air rotary and dual tube percussion drilling methods. Split-spoon or Shelby tube sampling may be conducted when drilling with mud rotary methods. However, when using this drilling method, the samples are not generally useful for chemical analyses. This is because the samples may become invaded or chemically altered when they are travel through the drilling mud during sample retrieval. In addition, loose unconsolidated soils may also literally wash out of the samplers when they travel through the mud column.

4.2.2 The procedures described in this SOP must be used in conjunction with the SOP prescribed for the specific drilling method used at the site. SOPs 14.1, 14.2, 14.3 and 14.4 specifically cover hollow stem auger, mud rotary, air rotary, and dual tube percussion drilling methods, respectively. Included in these drilling method SOPs are specific drilling requirements related to subsurface soil sampling. These also include, but are not limited to, site clearance, site preparation, and health and safety requirements. Consequently, the SOP for the specific drilling method to be used at the site, the task-specific sampling or work plans, and this SOP must be reviewed together before the initiation of drilling and sampling.

4.3 Split-Spoon Sampling

Split-spoon samples for chemical analysis are usually obtained in brass, plastic, or stainless steel sleeves. The types, dimensions and number of sleeves to be used, along with the length and type of sampler, will be stated in the task-specific sampling or work plans. The split-spoon sampler, lined with the sleeves, is connected to the drill rod string or a wireline sampling string and is driven by a hammer (140 or 340 pounds, depending on the size of the sampler) or drilling jars into the undisturbed soil below the bottom of the borehole. The procedure for collecting samples from the split-spoon sampler will be outlined in the task-specific sampling or work plans. The standard procedure is described below.

4.3.1 Calibrate all field analytical and health and safety monitoring equipment according to the instrument manufacturer's specifications. Calibration results will be recorded on the appropriate form(s) as specified by the task-specific sampling or work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

4.3.2 Wear the appropriate personal protective equipment as specified in the task-specific sampling or work plans and the applicable drilling method SOP. Personnel protection will typically include a hard hat, safety glasses, gloves, steel-toed boots, hearing protection, and coveralls.

4.3.3 Between each sampling location and prior to each sampling run, decontaminate the sampler, sleeves, and other sampling equipment as described in SOP 6.1.

4.3.4 Advance the borehole to the desired depth or target horizon where the sampling run is to begin. During drilling, monitor vapors in the breathing zone according to the task-specific sampling or work plans and drilling method SOP.

4.3.5 When the desired sampling depth or target horizon is reached, remove the drill bit or plug from inside the drive casing or augers.

4.3.6 Insert the sleeves into the split-spoon sampler, connect the halves, and screw together the rear threaded collar and front drive shoe. Attach the split-spoon sampler to the bottom end of the drill rod string or wireline sampling string. Set up and attach the specified weight hammer, if used.

4.3.7 Drive the sampler into the soil at the bottom of the borehole. Record the type of sampler assembly and hammer weight on the Borehole/Well Construction Log (Attachment 7.1) and/or other appropriate form(s), as specified in the task-specific sampling or work plans. To minimize off-gassing of the volatiles, the sampler should not be driven until the sampling team is ready to process the sample.

4.3.8 When conducting penetration testing, observe and record on the Borehole/Well Construction Log the number of hammer blows per six inches of penetration.

4.3.9 Pull the drill rod or wireline sampling string up from the bottom of the borehole and remove the sampler.

4.3.10 Remove the drive shoe and rear collar from the sampler and open the split barrel.

4.3.11 Remove the sleeves one at a time. Observe and record the amount of sample recovery on the Borehole/Well Construction Log. Any observed field problems associated with the sampling attempt (e.g., refusal) or lack of recovery should also be noted.

4.3.12 Select sleeve(s) to be submitted for laboratory analysis. Sample sleeve selection should be based on five factors: judgement that the sample represents relatively undisturbed intact material, not slough; proximity to the drive shoe; minimal exposure to air; lithology; and obvious evidence of contamination. The task-specific sampling or work plans will specify which sample sleeves will be submitted for specific analyses and confirm the selection criteria.

4.3.13 Place Teflon® film over each end of sleeves to be submitted for chemical analysis and seal each end with plastic end caps. Custody seals may be used for additional sample security.

4.3.14 Appropriately label and number each sleeve to be submitted for analysis per SOPs 17.1 and 17.2, respectively. The label will be completed using waterproof ink and will contain, at a minimum, the following information:

- Project number;
- Boring number;
- Sample number;
- Bottom depth of sleeve;
- Date and time of sample collection;
- Parameters for analysis; and,
- Sampler's initials.

4.3.15 Document the sampling event on the Borehole/Well Construction Log (Attachment 7.1) or an equivalent form as specified in the task-specific sampling or work plans. At a minimum, this log will contain:

- Project name and number;
- Date and time of the sampling event;
- Drilling and sampling methods;
- Sample number;
- Sample location;
- Boring number;
- Sample depth;
- Sample description;
- Weather conditions;
- Any detected odor, discoloration and/or other evidence of the presence of contaminants;
- Unusual events; and,
- Signature or initials of the sampler.

4.3.16 Appropriately preserve, package, handle, and ship the samples in accordance with the procedures outlined in SOP 2.1 and the task-specific sampling or work plans. The samples shall also be managed per SOP 1.1. Samples stored on site will be subject to the provisions of SOP 19.1.

4.3.17 Samples collected for volatile organic compound analysis by EPA Method 5035 must be collected and preserved in accordance with SOP 3.1, Surface and Shallow Subsurface Soil Sampling, Section 4.3.11.

4.3.18 One of the sample sleeves may also be utilized for lithologic logging per SOP 15.1. This sleeve may not then be retained for chemical analysis, as soil must be removed from the sleeve to effectively describe the soil/lithology and compile the lithologic log.

4.3.19 Where required by the task-specific sampling or work plans, remove the soil from one of the remaining sleeves and place in a seam-sealing, polyethylene bag for organic vapor screening. Place the bag in the sunlight for at least five minutes, then using an organic vapor probe (e.g., portable photoionization detector, flame ionization detector, or other appropriate instrument), monitor the soil for organic vapors. Record the reading on the Borehole/Well Construction Log (Attachment 7.1), the Sample Collection Log (SOP 3.1, Attachment 7.1), and any other form(s) specified in the task-specific sampling or work plans.

4.3.20 Repeat this sampling procedure at the intervals specified in the task-specific sampling or work plans until the bottom of the borehole is reached and/or last sample collected.

4.4 Continuous Core Sampling Method

Continuous core sampling system methods may be specified where continuous soil cores are to be recovered by direct-push coring methods (e.g., Geoprobe or Envirocore). The continuous core sampling method utilizes a core barrel, which recovers soil core from the interval through which the barrel is advanced. The barrel is recovered after the total depth of the boring is attained.

The standard procedure for collecting samples using a continuous core sampling device is described below.

4.4.1 Calibrate all field analytical and health and safety monitoring equipment as discussed in Section 4.3.1.

4.4.2 Wear the appropriate personal protective equipment as described in Section 4.3.2.

4.4.3 Between each sampling location, prior to each sampling run and/or as required, decontaminate the sampler and other sampling equipment as described in SOP 6.1.

4.4.4 Advance the continuous sampler to the desired depth or target horizon while monitoring the breathing zone according to the task-specific sampling or work plans and applicable drilling method SOP. A three-foot section of the sampler (consisting of inner sampling rods and outer drive casing) is driven into the ground .

4.4.5 After being driven three feet, the small diameter (1.5-inch) inner sampling rods are removed from the borehole using a hydraulic winch. The larger (2-inch) diameter drive casing is left in place to prevent the borehole from collapsing. Soil samples are collected in 1.5-inch diameter stainless steel sleeves inside the inner sample barrel. The sleeves are removed from the sample barrel and given to the site geologist or engineer for lithologic interpretation. New sleeves are then added to the sample barrel and it is lowered back into the borehole. An additional three or more feet of inner rods and outer drive casing are attached, and the process is repeated until the desired depth is reached.

4.4.6 Once the soil has been continuously cored to the desired depth, the inner sampling rods are removed, while the outer casing remains in place to hold the boring open. Observe and record the amount of sample recovery and any associated problems as discussed in Section 4.3.11.

4.4.7 Place Teflon® film over each end of the tube if it is to be submitted for chemical analysis and seal the ends with plastic end caps. Custody seals should be added for additional sample security.

4.4.8 Appropriately label and number the tube as described in Section 4.3.14.

4.4.9 Document the sampling event on the Borehole/Well Construction Log (Attachment 7.1) as discussed in Section 4.3.15.

4.4.10 Appropriately preserve, package, handle and ship the sample in accordance with the procedures outlined in SOP 2.1 and the task-specific sampling or work plans. The samples shall also be managed per SOP 1.1. Samples stored on-site will be subject to the provisions of SOP 19.1.

4.4.11 Samples collected for volatile organic compound analysis by EPA Method 5035 must be collected and preserved in accordance with SOP 3.1, Surface and Shallow Subsurface Soil Sampling, Section 4.3.11.

4.4.12 Repeat this sampling procedure continuously until the bottom of the borehole is reached and/or last sample collected as specified in the task-specific sampling or work plan.

4.4.13 Finally, cement grout is place in the borehole, from bottom to top, as the drive casing is withdrawn. This seals the borehole and prevents it from acting as a conduit for potential contaminant migration.

5.0 QUALITY CONTROL SOIL BLANK PREPARATION

One quality control soil blank will be sent with each shipment requiring analysis for volatile organic compounds. The soil blank will be prepared according to the following procedure:

5.1 Collect approximately eight ounces of soil from the container labeled "QC blank soil" located on the table in the on-site laboratory.

5.2 Lay the soil evenly over a one-foot by one-foot square of aluminum foil and place it under the heat lamps.

5.3 Adjust the lamps so that the soil temperature stabilizes at approximately 115 degrees (°) Celsius (C), ±15° (240° Fahrenheit [F], ±30°).

5.4 Shut the lamps off and measure the temperature of the soil with the digital thermometer after temperature stabilization. Record the temperature in a field notebook and turn the lamps back on.

5.5. Heat the soil for one hour.

5.6 After the one-hour period, shut the lamps off and measure the temperature again. If the second temperature measurement is above 100°C (212°F), then record the temperatures in a field notebook and proceed to Step 5.7. If the second measurement is below 100°C (212°F), then adjust the lamps to achieve a temperature greater than 100°C for one hour and measure the beginning and ending temperatures. Record the temperatures in a field notebook.

5.7 Allow the soil to cool below 50°C (122°F), then collect and preserve the sample in accordance with SOP 3.1, Surface and Shallow Subsurface Soil Sampling, Section 4.3.11.

5.8 Assign the sample an identification number that is indistinguishable from the rest of the soil samples to be collected, so the blank will not be obvious to the laboratory.

5.9 Ship the soil blank with other soil samples on the same chain-of-custody form.

6.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

7.0 ATTACHMENT

7.1 Borehole/Well Construction Log

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the Project Quality Assurance Manager, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 7.1

BOREHOLE/WELL CONSTRUCTION LOG

WEISS ASSOCIATES

BOREHOLE / WELL CONSTRUCTION LOG

Page ____ of ____

BOREHOLE LOCATION	Project: (facility, address, city, state)	Borehole/Well No:
		Job No:
	Logged By:	Edited By:
	Project Manager:	Drill Rig:
	Drilling Contractor: (name, city, state)	
	Driller:	License # : C57-
	Drilling Method:	Sample Method:
	Well Head Completion:	Ground Surface Elevation:
	Hammer Weight/Drop:	Borehole Diameter:
	Started, Time:	Date:
	Completed, Time:	Date:
	Water Depth	
Approximate Scale:	Boring/Casing Depth	
Notes:	Time	
	Date	

Sample ID	PID / FID (ppm)	Sampler Type / depth	Blows per 6 Inches	Inches Driven	Inches Recovered	Sample Condition	Boring Diameter	Diagram: Conductor Casing(s) Interval and Diameter	Diagram: Sand / Grout	Diagram: Well Casing / Screen	Depth in Feet	Recovery / Sample Loc.	Contact / Hyd. Conduct.	LITHOLOGIC DESCRIPTIONS
											1			
											2			
											3			
											4			
											5			
											6			
											7			
											8			
											9			
											10			

Total Boring Depth: | Total Well Depth:
Screened Interval: | Well Diameter:
Sand Pack (Type and Interval):
Well Development Method:
Time: Date: Flow Rate:
Geophysical Logs, Type:
By: Date:

WEISS ASSOCIATES

BOREHOLE / WELL CONSTRUCTION LOG (cont.)

Page ____ of ____

Project / Job No.:

Borehole/Well No.:

Notes:

Sample ID	PID/FID	Sampler Type	Blows / 6 Inches	Inches Driven	Inches Recov'd	Sample Cond.	Boring Diameter	Conduct. Casing	Sand / Grout	Well Casing	Depth (ft)	Recovery	Contact
											1		
											2		
											3		
											4		
											5		
											6		
											7		
											8		
											9		
											0		
											1		
											2		
											3		
											4		
											5		
											6		
											7		
											8		
											9		
											0		

COMPACTION OF FILL MATERIAL

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) establishes methods and responsibilities for compaction of earth fill for construction purposes to produce a soil that meets design specifications for strength, compressibility, stability against volume charge, and/or durability and safety against deterioration.

The purpose of this document is to provide general recommended methodologies for compaction of earth fill. This document does not include all methods, conditions, situations, or difficulties that may arise during compaction. For site specific information, an experienced and qualified engineer knowledgeable in earth fill compaction should be consulted.

2.0 REFERENCES

2.1 *Essentials of Soil Mechanics, Third Edition, David F. McCarthy*

2.2 *An Introduction to Geotechnical Engineering, Robert D. Holtz and William D. Kovacs*

2.3 *ASTM D1557 (1994) - Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457 mm) Drop*

2.4 *ASTM D2922 (1994) - Density of Soil and Soil-Aggregate in Place by Nuclear Density Methods (Shallow Depth)*

2.5 *ASTM D3017 (1994) - Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)*

3.0 DEFINITIONS

3.1 Expansive Clays

Expansive clays are clays that are susceptible to large volume changes that are directly related to changes in water content. The swelling forces of this clay can cause enough surcharge to lift pavements and light structures.

3.2 Cohesive Soil

Fine grained particles (i.e., silt and clay) that form clusters because each individual grain has high interparticle bonding properties.

3.3 Cohesionless Soil

Grains of soil (i.e., sands) that can settle out of a soil-fluid suspension independently of other grains.

3.4 Modified Proctor Test

The test produces a unique curve that relates a soil's water content to its maximum density. The test is used to determine the optimum moisture content for a soil so that maximum compaction can be achieved.

3.5 Backfill

Soil material placed back into an area that has been excavated.

4.0 PROCEDURE

The procedure will explain some acceptable methodologies to achieve design-specified compaction.

4.1 Discussion

When soil is used for construction, it is normally placed in layers, the layer thickness determined by a qualified engineer. Each layer is compacted according to specifications before the next layer is placed. The following sections will explain some acceptable methods to achieve soil compaction.

4.2 Responsibilities

4.2.1 The Construction Engineer has the responsibility to instruct his operators and technicians to implement compaction activities. The Construction Engineer will be responsible for insuring that there is sufficient quantity of fill soil for the compaction operation, that the fill soil is suitable material, and that the fill soil has proper moisture content. He will also provide support for the Field Engineer.

4.2.2 The Field Engineer has the responsibility to insure that the height of each lift follows the design specifications, the number of passes by the compaction equipment is sufficient to reach the design compaction specifications, the final grade is at the required design elevation, and that the compacted soil has reached the specified density.

4.2.3 The Field Engineer's duties will involve sampling the fill soil, obtaining a five point modified Proctor curve to determine maximum dry density of the soil and optimum moisture content, and using a device to determine in-place density. If the compacted soil does not meet the specified density, the PEG has the responsibility to inform the Construction Superintendent.

4.3 Preparation

4.3.1 Fill soil is needed as compaction material for an excavation or trench. If the existing soil cannot be used as fill material, then fill soil must be imported from another source. Almost all soil can be used as fill soil provided it does not contain either organic material that can decompose, foreign material that can undergo changes after it is in place, or contaminated material. A qualified engineer will examine all fill soil before the soil is placed in the excavation.

4.3.2 Granular soils are considered the easiest material to compact. This material can gain high strength with compaction. After the material is compacted, there will be minimal volume change.

4.3.3 Silty soils can gain reasonable strength with little propensity for volume change. Moisture control is important in the proper compaction of silty soils.

4.3.4 Compacted clay can gain relatively high strengths. Moisture control is important in the proper compaction of clay soils.

4.3.5 Fill soil is generally placed in an excavation with a self-propelled scraper or bulldozer. A bulldozer or grader is generally used in the fill area to maintain a uniform spread of fill soil.

4.3.6 The thickness of the soil placement will vary depending on the weight of the compaction equipment. Recommended thickness of soil layers is outlined in Section 4.3.4.

4.3.7 Fine-grained silt and clay soils that appear too wet to compact should be substituted by a dryer soil. If it is not feasible to import soil, scarification and aeration can be utilized to reduce the existing soil moisture content. Water should be added to a soil that is too dry. The water should be evenly mixed into the soil.

4.3.8 The type of compaction equipment and the method of compaction depends on the soil type and the soil conditions.

The "sheepsfoot roller" or similar roller with projecting studs that compact through a combination of kneading and tamping is effective on cohesive soils like clay and silt-clay soils. The depth and compaction of a soil layer placed depends on the length of the studs, the weight of the roller, and the number of passes the equipment places on the soil layer. Generally, a large, heavy roller with long studs can compact a 12-inch soil layer in three to five passes. Small, light rollers with shorter studs should be limited to layers less than six inches thick.

The pneumatic tire roller is effective for compacting both cohesive and cohesionless soils. It is the best compaction for general compaction use. Generally, a light pneumatic tire roller can properly compact a six-inch soil layer with three to five passes. The heaviest pneumatic tire loader can typically compact an 18 inch soil layer with three to five passes.

Vibratory compactors are most effective on granular soils having a low to no silt/clay sized materials. Vibratory compactors can either be in the form of a "sheepsfoot roller" or a pneumatic tire roller. The thickness of the soil layer depends on the weight of the compactor.

4.4 Compaction Implementation

After the soil is classified by a qualified engineer, the soil optimum moisture content and maximum dry density is determined through laboratory methods (ASTM D1557). This will enable the Construction Superintendent to determine whether the existing fill is suitable for compaction. If the material is not suitable, compactable fill soil must be imported. After the fill soil is approved, the compaction equipment is chosen and the site is prepared for compaction. The soil is placed in a series of layers. Each soil layer is compacted with the compaction equipment before the following layer is placed. Generally, the top few inches of the lift is scarified before the next lift is placed. Soil layers are placed until the work area is flush with the existing ground surface or as dictated by the design specification. The final layer is not scarified.

4.5 Field Control

Field control is the responsibility of the PEG. The PEG will verify the compaction work.

4.5.1 After the lift is thoroughly compacted, the PEG verifies that the lift has met the compaction criteria. On structural earth fills, the job will normally specify the degree of compaction that must be achieved in order for the soil layer to be considered acceptable. This job specification is generally based on the results of laboratory compaction tests, such as a moisture-density test, performed on a representative sample of fill soil. A recommended method to determine the moisture density relationship is the modified Proctor test (ASTM D1557). The PEG must obtain at least five gallons of soil for the test. Additionally, it is recommended that the PEG obtain two gallons of fill soil every 100 cubic yards for a one-point modified Proctor test. The one point test will help the PEG determine whether the soil conditions deviate from the conditions determined from the original Proctor test.

4.5.2 Field density tests are done using the results of the modified Proctor curve performed on the fill soil. The information obtained from the curve, both the optimum moisture content and the maximum dry density, is entered into a nuclear density gage. It is general practice to perform in-place density tests with a nuclear density gauge (ASTM D2922 and D3017). It is typical to test at several random locations after the soil layer is compacted. The elevation of the test location is also taken. The density of the compacted fill, the moisture of the fill soil, the percent compaction, and the elevation is recorded on a form. It is recommended that the gauge reading and the elevation be recorded on a map of the work area. When the test results indicate that satisfactory compaction has been obtained, the PEG will inform the Construction Supervisor.

4.6 Compaction Difficulties

Compaction difficulties include underground buried structures and problem soils.

4.6.1 If there are buried structures, the location and depth of the structure should first be determined. Work will not proceed until a qualified engineer determines the amount of backfill or a different compaction methodology required to prevent damage to the buried structure.

4.6.2 Expansive clays, like those containing the montmorillonite mineral, are prone to large volume changes in the presence of water. The volume change could lift pavements and/or small structures. It is considered poor foundation material unless it can be protected from the effects of water.

5.0 RECORDS

The original and originals of revision of the Nuclear Density/Moisture, an attached location map, and Field Activity Daily Logs will be controlled and maintained in the record files.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

WATER LEVEL MEASUREMENTS IN MONITORING WELLS

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for personnel to use in determining the depth to water in monitoring wells.

2.0 REFERENCES

2.1 *EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER 9950.1, U.S. Government Printing Office, Washington, D.C.*

2.2 *EPA, 1991, Environmental Compliance Branch, standard Operating Procedures and Quality Assurance Manual, Region IV, Environmental Services Division, Athens, Georgia, U.S. Government Printing Office, Washington, D.C.*

2.3 *SOP 5.2 - Non-Aqueous Phase Liquid Measurements in Monitoring Wells*

2.4 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.5 *SOP 4.2 - Records Management*

3.0 DEFINITIONS

None

4.0 PROCEDURE

Water level measurements are commonly taken in each monitoring well immediately prior to, during, and following well development, and both before and after well purging and sampling. Water level measurements may also be taken where no development or purging is being conducted, strictly to monitor or generate water table or piezometric surfaces. When such measurements are made to monitor water table or piezometric surfaces, water levels in all wells at a given site should be measured within a 24-hour maximum period whenever possible. When measuring wells for water table or potentiometric surface analysis, and if the contaminant history is known for each of the wells, it is advisable to monitor water levels beginning with the least contaminated wells first and progressing to the most contaminated wells last.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that monitoring well water level measurements are properly collected and documented. This will be accomplished by staff training and by maintaining quality assurance/quality control (QA/QC)

4.1.2 The Project QA Specialist (PQAS) is responsible for the periodic review of documentation generated as a result of this SOP and the periodic review and audit of field personnel as they perform the work. If problems arise, the PQAS is also responsible for verifying implementation of corrective action(s) (i.e., retraining personnel, additional review of work plans and SOPs, variances to requirements, and issuing nonconformances) and assuring through monitoring the continued implementation of stated corrective actions.

4.1.3 Field sampling personnel assigned to this task are responsible for the proper collection and documentation of the monitoring well water level measurements. All staff are responsible for reporting desertions from procedures to the Field Coordinator or the PQAS.

4.2 Equipment Selection

4.2.1 A number of devices are available for the determination of water level measurements in monitoring wells. Those most commonly used and covered in this SOP include: steel tapes, electric sounders, and petroleum product probes. The equipment must be capable of recording a measurement to the accuracy required by the project work plans.

4.2.2 Project data quality objectives and site characteristics must be taken into account when determining the water level measurement equipment to use. The total number of wells to be measured, weather, tidal influences, pumping, and construction can all affect water level measurements. The project-specific work plans will identify the specific equipment to be used.

4.3 Determining Water Level Measurements in Monitoring Wells

The standard procedure for determining depth to water is described below.

4.3.1 Calibrate all measuring devices according to the manufacturer's specifications. Measuring tapes should be checked a minimum of every six months against a surveyor's tape to determine if shrinking or stretching has occurred.

4.3.2 Prior to taking a water level measurement at each well, decontaminate the measuring device according to the procedures outlined in SOP 6.1. During decontamination, all measuring tapes should be inspected for kinks, cracks, or tears and, if present, repaired or replaced with undamaged equipment.

4.3.3 Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Any damage or problems with the well head should be noted on the Field Activity Daily Log (FADL) (SOP 1.1) and the Site Coordinator notified for repair or replacement of the equipment.

4.3.4 Uncap the well and monitor the air space immediately above the open casing per the project-specific health and safety plan. Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the Water Levels form, Well Development Data form or Water Sampling Data form (Attachments 6.1, 6.2, and 6.3, respectively) as appropriate. Lower the electric sounder of equivalent (product probe or steel tape) into the well until the water surface is encountered. If air is observed to be entering flowing out of the casing, the sounder should not be placed inside the well until the air flow stops and pressure equalizes.

4.3.5 Measure the distance from the water surface to the permanent reference point. For aboveground "stickup" completions, the reference point is usually a groove cut into the north side of the casing. If no permanent reference point is available for an aboveground completion, measure from another permanently fixed structure or from ground level. The point of measurement should then be noted on the FADL and the appropriate form on which the water level is recorded. For flush mount completions, such as street boxes, the water level measurement should be referenced to the rim of the street box. Any aboveground completions without permanent reference points or marks should be brought to the attention of the appropriate supervisory personnel per the project-specific work plan.

4.3.6 Collect measurements until two consecutive measurements are identical or within the specified tolerance of the project-specific work plans (usually 0.01 ft.). Record all appropriate information on either the Water Levels form, Well Development Data form, or the Water Sampling Data form, depending upon the task being performed. At a minimum, the following information must be recorded:

- Project name and number;
- Unique well identification number;
- Date and time of measurement collection;
- Depth to water; and,
- Any problems encountered.

4.3.7 If product or other non-aqueous liquid is encountered, follow the procedures outlined in SOP 5.2.

4.3.8 Cap and re-lock the well.

5.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project records files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Water Levels Form

6.2 Well Development Data Form

6.3 Water Sampling Data Form

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

WATER LEVELS FORM

WATER LEVELS

Job Name: ______________________________

WA Job #: ______________________________

Method / Equipment: ______________________________

Date Measured :______________________________

Initials: ______________________________

Well ID	Measurement Point	T.O.C. Elevation	Historical D.T.W. 2nd Most Recent Date:	Historical D.T.W. Most Recent Date	Field D.T.W.	Clock Time (Military)	Comments (Well condition special access, etc.)

ATTACHMENT 6.2

WELL DEVELOPMENT DATA FORM

Weiss Associates

Well Development Data

Page ____ of ____

Project Name ______________________________ Project Location ______________________________

Weather Conditions ______________________________ Job No. ______________________________

Well ID Number ______________________________ Date ______________________________

Development Method(s) ______________________________ By ______________

Depth to Water Before Development (ft) __________ Reference Elevation ______________________

Well Diam. (in.) ____ Screened Interval (ft) ________________ Well Depth (ft) ________________

Time	Depth to Water (ft)	Gallons Pumped	Flow Rate (gpm)	Comments (water clarity, odor, methods, sounded depth, etc.)

Well Development Summary

Depth to Water During Pumping (ft) ____________ Approximate yield ______________________

Depth to Water after Development ____________ Average Pumping Rate (gpm) ________________

Sounded Depth After Development ____________ Pumping Rate Range (gpm) ________________

Total Pumping Time (min) ____________________ Total H_20 Injected (gals) ________________

Total Amount Evacuated (gals) ________________ Well Development Observer ________________

ATTACHMENT 6.3

WATER SAMPLING DATA FORM

WATER SAMPLING DATA

Weiss Associates

PROJECT DATA:
Well Name __________ Date __________ Time of Sampling __________
Job Name __________ Job Number __________ Initials ____
Sample Point Description __________ (M = Monitoring Well) Location __________
WELL DATA: Depth to Water ______ ft (static, pumping) Depth to Product ______ ft.
Product Thickness ______ Well Depth ______ ft (spec) Well Depth ______ ft (sounded) Well Diam ______in
Initial Height of Water in Casing __________ ft. = volume __________ gal.
______ Casing Volumes to be Evacuated. Total volume to be evacuated: __________gal.
EVACUATION METHOD Pump # and type __________ Hose # and type __________
Bailer# and type __________ Dedicated __________(Y/N)
Other __________
Evacuation Time: Stop ______ ______ ______ ______
Start ______ ______ ______ ______
Total Evacuation Time ______
Total Evacuated Prior to Sampling ______ gal.
Evacuation Rate __________ gal. per minute
Depth to Water during Evacuation ______ ft. ______ time
Depth to Water at Sampling ______ ft. ______ time
Evacuated Dry? ______ After ______ gal. Time ______
80% Recovery = __________
% Recovery at Sample Time __________ Time ______

Formulas/Conversions
r = well radius in ft.
h = ht of water col in ft.
vol. in cyl. = $\pi r^2 h$
7.48 gal/ft^3
$V_{2"}$ casing = 0.163 gal/ft
$V_{3"}$ casing = 0.367 gal/ft
$V_{4"}$ casing = 0.653 gal/ft
$V_{4.5"}$ casing = 0.826 gal/ft
$V_{6"}$ casing = 1.47 gal/ft
$V_{8"}$ casing = 2.61 gal/ft

CHEMICAL DATA: Meter Brand/Number __________
Calibration: ______ 4.0 ______ 7.0 ______ 10.0
Measured:

SC/❍mhos	pH	T°C	Time	Volume Extracted (gal.)

SAMPLE: Color __________ Odor __________
Description of matter in sample: __________
Sampling Method: __________
Sample Port: Rate ____gpm Totalizer__________gal Time __________

# of Cont.	Sample ID	Cont. Type[1]	Vol[2]	Fil[3]	Ref[4]	Preservative (specify)	Analytic Method	Turn[5]	LAB

1 Sample Type Codes: W = Water, S = Soil, Describe Other
Container Type Codes: V = VOA/Teflon Septa, P = Plastic, C or B = Clear/Brown Glass, Describe Other
Cap Codes: PT = Plastic, Teflon lined;
2 = Volume per container; 3 = Filtered (Y/N); 4 = Refrigerated (Y/N)
5 Turnaround [N = Normal, W = 1 week, R = 24 hour, HOLD (spell)]

ADDITIONAL COMMENTS, CONDITIONS, PROBLEMS:

NON-AQUEOUS PHASE LIQUID MEASUREMENT IN MONITORING WELLS

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for field personnel to use in determining the thickness of non-aqueous phase liquid in monitoring wells. The details within this SOP should also be used in conjunction with project work plans.

2.0 REFERENCES

2.1 *EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, U.S. Government Printing Office, Washington, D.C.*

2.2 *EPA, 1991, Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual, Region IV, Environmental Services Division, Athens, Georgia, U.S. Government Printing Office, Washington, D.C.*

2.3 *SQP 4.2 - Records Management*

2.4 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

3.0 DEFINITIONS

3.1 Product

For the purposes of this procedure, product refers to liquid that is petroleum based (e.g., gasoline, diesel, or petroleum byproducts) or chlorinated hydrocarbon based (e.g., trichloroethene, tetrachloroethene, etc.).

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that non-aqueous phase liquid in monitoring wells is properly measured and documented. This will be accomplished by staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for the periodic review of documentation associated with this SOP and the periodic review and audit of field personnel as they perform the work. If perceived variances occur, the PQAS is also responsible for issuing notices of nonconformance and requests for corrective action.

4.1.3 Field sampling personnel are responsible for the proper measurement and documentation of the non-aqueous phase liquid measurement in monitoring wells. All staff are responsible for reporting derivations from procedures to the Field Coordinator or the PQAS.

4.2 Equipment Selection

4.2.1 This procedure addresses the operation of two types of equipment used to measure non-aqueous phase liquids (NAPLs) in monitoring wells: product probes and clear bailers. Clear bailers include both single- and double-check valve bailers. Single check valve bailers can only be used for measuring light non-aqueous phase liquids (LNAPLs) or floating products. Double check valve bailers can be used for measuring both LNAPLs and dense non-aqueous phase liquids (DNAPLs) or sinking product.

4.2.2 Several problems can arise in measuring product thickness with either product probes or clear bailers. Product probes can malfunction, particularly when measuring degraded or weathered product that sticks to the probe sensors. When the thickness of the product layer in a well is greater than the length of the bailer, the product layer cannot be accurately measured with the bailer. Consequently, it is recommended that both methods be used (one to check the other) to measure product thicknesses in wells. The project work plans will identify the specific equipment to be used.

4.3 Product Probe Procedure

4.3.1 The product probe, sometimes called an immiscible layer probe, is a device that can detect the presence of both LNAPLs and DNAPLs (both "floating" and "sinking" layers) in water wells. The device detects the difference in conductivity or specific gravity between the aqueous and non-aqueous phases in the well. The device is generally a probe connected to a measuring tape with a reel. The device contains a receiver with an audio and/or visual signal that indicates when phase changes occur. The standard procedure for using a petroleum product probe is described below.

4.3.2 Check the accuracy of the measuring tape of the petroleum product probe according to the manufacturer's specifications. Measuring tapes should be checked at least every six months against a surveyor's tape to determine if shrinking or stretching has occurred.

4.3.3 Prior to taking a measurement and between wells, decontaminate the probe and tape measure according to the procedures outlined in SOP 6.1. It is extremely important to conduct thorough decontamination to prevent cross-contamination between wells. During decontamination, all measuring tapes should be inspected for kinks, cracks, or tears and, if present, repaired or replaced with undamaged equipment.

4.3.4 Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Any damage or problems with the well head should be noted on the Field Activity Daily Log (FADL) (SOP 1.1) and notify the Site Coordinator per the project work plans.

4.3.5 Uncap the well and monitor the air space immediately above the open casing following the appropriate health and safety procedures. Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the Water Levels form (SOP 5.1), Well Development Data form (SOP 5.1), or Water Sampling Data form (SOP 5.1) as appropriate. If air is observed to be flowing into or out of the casing, the probe should not be placed inside the well until the air flow stops and pressure equalizes. Lower the probe into the well until the liquid surface is encountered. Continue lowering the probe, recording the depths at which any audio or visual changes in the device indicate a phase change. When measuring for DNAPL, continue lowering the probe to the bottom of the well. When measuring for LNAPL, there is no need to lower the probe further once the product/water interface is encountered and measured.

4.3.6 While lowering the probe, measure the distances to the encountered phase/phases from the permanent reference point. For aboveground "stick-up" completions, the reference point is usually a groove cut into the north side of the casing. If no permanent reference point is available for an aboveground completion, measure from another permanently fixed structure or from ground level. The point of measurement should then be noted on the FADL and the appropriate form on which the water level is recorded.

4.3.7 For flush mount completions, such as street boxes, the water level measurement should be referenced to the rim of the street box. Any aboveground completions without permanent reference points or marks should be brought to the attention of the Site Supervisor per the project work plans.

4.3.8 Collect measurements until two consecutive measurements are identical or within tolerances specified in the project work plans. Record all appropriate information on either the Water Levels form, Well Development Data form, or the Water Sampling Data form, depending upon the task being performed. At a minimum, the following information must be recorded:

- Project name and number;
- Well identification number;
- Date and time of measurement collection;
- Depth to water to the specified tolerance;
- Depth to and description of any non-aqueous phase liquid encountered; and,
- Comments, including any problems encountered.

4.3.9 Cap and relock the well.

4.4 Bailer Procedure

4.4.1 A single check-valve bailer is a cylindrical tube, open at the top and containing a floating ball at the bottom. Lowering the bailer into liquid allows the bottom ball to float, allowing floating product or water to enter the bailer. The design of this type of bailer only allows collection of a floating product (LNAPL) sample.

4.4.2 A double check-valve bailer is an enclosed cylindrical tube containing a floating ball at both the top and the bottom. Lowering the bailer into liquid causes both balls to float allowing water or product to enter the cylinder. Raising the bailer through the water causes both balls to settle, effectively trapping a discrete section of the water so that it can be brought to the surface. Since the double check-valve bailer is capable of collecting a discrete sample at any depth within the well, it can be used on both "floating" and "sinking" non-aqueous liquids.

4.4.3 The bailers must be constructed of clear material so that any product can be visibly measured. Some are also available with graduated markings on the side to allow easier measurement. The standard procedure for using bailers to measure non-aqueous phase liquids in monitoring wells is described below.

4.4.4 Bailers are commonly used with a thin nylon line or "cord" made of similar material. Some are supplied with a connectable measuring tape.

4.4.5 Check the accuracy of the measuring tape to be used with the bailer according to the manufacturer's specifications. Measuring tapes should be checked a minimum of every six months against a surveyor's tape to determine if shrinking or stretching has occurred.

4.4.6 Prior to taking a measurement and between wells, decontaminate the bailer and tape measure according to the procedures outlined in SOP 6.1, Sampling Equipment and Well Material Decontamination. If a bailer line is used, it is advised to cut and dispose of any line run inside a previous well. Bailers used for product sampling should never be used for purging or collecting water samples.

4.4.7 If product probe measurements are to be used in conjunction with a bailer, the probe measurements should first be made, recorded, and noted by field personnel taking the measurements.

4.4.8 If bailer measurements are to be taken before or without product probe measurements, visually inspect and document well head conditions per 4.3.4 above. Uncap the well and monitor and observe the well head per 4.3.5 above.

4.4.9 Lower the bailer into the well until the liquid surface is encountered. Use the measuring tape if available to determine the depth to which the bailer should be lowered to recover either the LNAPL or DNAPL product.

4.4.10 If using bailer cord and attempting to recover DNAPL ("sinking") product, a double check-valve bailer may simply be run to the bottom of the well. If attempting to recover LNAPL ("floating") product using bailer cord, it is advisable to first note the depths to product and water made with the product probe and mark the depths on the bailer cord with a rubber band or twine.

The bailer (either single or double check-valve) should then be lowered such that the bailer retrieves product and does not run completely through the product layer, thereby retrieving only water.

4.4.11 If no product probe measurements are available, the person attempting to retrieve the bailer product sample will then have to "feel" for first contact with the liquid while the bailer is descending inside the well. Once the contact is felt, the bailer descent should be halted. The bailer should then be slowly lowered no more than ¾ of its total length to avoid overtopping. Retrieve the bailer and visually inspect for product. Measure the amount of product contained in the bailer with the measuring tape. Note any appropriate conditions observed in the bailer such as:

- Color and clarity of the product;
- Length of product column in bailer compared to overall length of bailer;
- Evidence of any problems with the bailer valves; and,
- Evidence of overtopping or complete run through the product column.

4.4.12 Record all appropriate information on either the Water Levels form, Well Development Data form, or the Water Sampling Data form, depending upon the task being performed. At a minimum, the following information must be recorded:

- Project name and number;
- Well identification number;
- Date and time of measurement collection;
- Depth to water, if available, to the appropriate tolerance specified in the project work plans;
- Measurement and description of any non-aqueous phase liquid encountered;
- Any observations made in 4.3.5 above; and,
- Comments, including any problems encountered.

4.4.13 Cap and relock the well.

5.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form

SAMPLING EQUIPMENT AND WELL MATERIAL DECONTAMINATION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the decontamination of sampling equipment and well construction materials. Proper equipment decontamination is essential in ensuring the quality and integrity of samples collected during a given sampling event. Additional specific sampling equipment and well material decontamination procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *EPA, September 1987, EPA Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14*

2.2 *EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.3 *SOP 6.2 - Drilling and Heavy Equipment Decontamination*

2.4 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Deionized Analyte-Free Water

Ion-free, analyte-free water produced on site or purchased from a supplier with a deionization chamber equipped with a carbon filter.

3.2 Potable Water

Treated municipal water, or other drinking-grade water.

3.3 Laboratory Grade Detergent

A standard brand of laboratory-grade detergent, such as "Alconox" or "Liquinox."

3.4 Methanol

Laboratory-grade methanol alcohol, CAS #67-56-1.

3.5 Hexane

Laboratory-grade hexane, CAS #110-54-3.

3.6 HPLC Water

High performance liquid chemotrgraphy-grade water.

4.0 PROCEDURE

This section contains responsibilities, requirements, and procedures for sampling equipment and well material decontamination. The decontamination is required to maintain proper quality and integrity of collected samples.

The details within this SOP should be used in conjunction with the project work plans. The project work plans will provide the following information:

- Types of equipment requiring decontamination under this SOP;
- Specific materials to be used for the decontamination; and
- Additional decontamination requirements and procedures beyond those covered in this SOP, as necessary.

All field personnel associated with decontamination of sampling equipment or well materials must read both this SOP and the project work plans prior to implementation of related decontamination activities. Information and requirements for the decontamination of any and all drilling and heavy equipment is provided in SOP No. 6.2.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sampling equipment and well material decontamination activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to decontamination requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sampling equipment and well material decontamination activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 Decontamination Facility

If possible, sampling equipment decontamination will take place in an area designed exclusively for decontamination. This area will ideally be located within the contamination reduction zone on the project site. Well materials may be decontaminated at the facility set up for decontamination of drilling and heavy equipment (see SOP No. 6.2).

Each decontamination facility will be constructed so that the equipment, as well as all wastes generated during decontamination (e.g., soil, rinsate, liquid spray, debris, etc.), are contained to the extent appropriate. In addition, chemical products used in the decontamination process must be properly containerized and labeled.

4.3 Decontamination of Non-Dedicated Sampling Equipment

Each piece of reusable, non-dedicated sampling equipment will be decontaminated before each sampling event. The standard procedure will be performed as described below.

4.3.1 Suitable personal protective equipment (specified by the project work plans) must be worn by all personnel involved with the task to reduce personal exposure.

4.3.2 Heavily caked soil and/or other material will be scraped or brushed from equipment. Steam cleaning of equipment may be required to remove material from samplers.

4.3.3 Equipment that will not be damaged by water should be placed into a wash tub containing a laboratory-grade detergent solution and scrubbed with a brush or clean cloth. Rinsing will then be conducted with fresh, potable water, followed by deionized water.

4.3.4 Methanol, hexane, and HPLC water rinses may then follow for some sampler components when specified by the project work plans.

4.3.5 Any equipment that may be damaged by submersion into water will be wiped clean using a sponge and detergent solution. Cleaning will be followed by wiping the equipment with deionized water.

4.3.6 Air dry the rinsed equipment. Soil organic vapor (SOV) sampling equipment should be flushed dry with bottled air of known quality and/or as per the project work plans.

4.3.7 Place decontaminated equipment on clean plastic sheeting to prevent contact with contaminated soil. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

4.3.8 Decontamination activities will be documented on the Field Activity Daily Log (FADL) (SOP 1.1) or other appropriate form(s), as specified by the project work plans.

4.4 Decontamination of Dedicated Sampling Equipment

Dedicated sampling equipment, such as submersible pumps, will be decontaminated prior to installation inside monitoring wells. At a minimum, the procedure outlined below must be performed. If factory-cleaned, hermetically sealed materials are used, no decontamination will be necessary, provided that laboratory decontamination certification is submitted with the equipment.

4.4.1 Suitable personal protective equipment will be worn by all personnel involved in the task, in accordance with the project work plans.

4.4.2 Pumping lines will be washed with a laboratory-grade detergent solution.

4.4.3 The equipment will then be rinsed twice with tap water, followed by a rinse with deionized water.

4.4.4 Air dry.

4.4.5 Place decontaminated equipment on clean plastic sheeting to prevent contact with contaminated soil. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

4.4.6 Decontamination activities will be documented on the FADL or the appropriate form(s), as specified by the project work plans.

4.5 Decontamination of Well Materials

Well materials including well casing, well screens, centralizers, and end caps will be decontaminated prior to use in constructing monitoring wells. (If factory-cleaned, hermetically sealed material are used, no decontamination will be necessary, provided that laboratory decontamination certification is submitted with the equipment.) The standard procedure outlined below must be performed when decontaminating well materials.

4.5.1 Appropriate personal protective equipment will be worn by all personnel involved in the task, in accordance with the project work plans.

4.5.2 Materials will be thoroughly sprayed and washed with water using a high pressure steam cleaner.

4.5.3 Air dry.

4.5.4 Decontaminated materials will be placed on clean metal racks or clean plastic sheeting. If equipment is not used immediately, cover or wrap the equipment in clean plastic sheeting to minimize airborne contamination.

4.5.5 Decontamination activities will be documented on the FADL or other appropriate form(s), as specified by the project work plans.

5.0 RECORDS

Records generated as a result of this SOP will be maintained in the Project Records file in accordance with SQP No. 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form

DRILLING, DEVELOPMENT AND HEAVY EQUIPMENT DECONTAMINATION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for use by field personnel in the decontamination of drilling, development and heavy equipment. The details within this SOP are applicable as general requirements for drilling, development and heavy equipment decontamination, and should also be used in conjunction with project work plans.

2.0 REFERENCES

2.1 *EPA, September 1987, EPA Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14*

2.2 *EPA, August 1988, EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.3 *SQP 4.2 - Records Management*

2.4 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

3.0 DEFINITIONS

3.1 Laboratory Grade Detergent

A standard brand of laboratory-grade detergent, such as "Alconox" or "Liquinox."

3.2 Potable Water

Water dispensed from a municipal water system, or other drinking-grade water.

4.0 PROCEDURE

4.1.1 Compliance with this procedure is the responsibility of project management and field personnel. This SOP and the project work plans should be reviewed before implementing drilling, development, and heavy equipment decontamination at the project field area.

4.1.2 The Project Manager has the responsibility for ensuring that the decontamination of drilling, development and heavy equipment is properly performed through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.3 The Project QA Specialist (PQAS) has the responsibility for periodic review of procedures and documentation associated with the decontamination of drilling, development and heavy equipment. If perceived variances occur, the PQAS is also responsible for issuing notices of nonconformances and requesting corrective actions. Additionally, he/she will perform inspections and may monitor the decontamination activities.

4.1.4 The project staff assigned to drilling, development, trenching, or construction activities are responsible for ensuring that subcontractors or equipment operators properly decontaminate the drilling, development, and heavy equipment associated with those tasks. The project staff are also responsible for documenting the decontamination activities on the Field Activity Daily Log (FADL) (SOP 1.1) and/or appropriate form(s) as specified in the project work plans.

4.2 General

4.2.1 This section provides requirements for the set up of a decontamination facility for drilling, development, and heavy equipment and the decontamination procedures to be followed. The project work plans will provide specific information regarding:

- Types of equipment requiring decontamination under this SOP;
- Location of the decontamination station;
- Types and/or specifications on materials to be used in the fabrication of the decontamination station; and,
- Types of materials and additional details on the procedures to be used in the decontamination process.

4.2.2 All field personnel associated with either the fabrication of the decontamination station or the decontamination of drilling, development or heavy equipment must read both this SOP and the project work plans prior to implementation of related decontamination activities. Information and requirements for the decontamination of any and all equipment used specifically for sampling is presented in SOP 6.1.

4.3 Decontamination Facility

4.3.1 A decontamination station will be set up in an area exclusively for decontamination of drilling, well development, and/or heavy equipment. The location of the decontamination station will be specified in the project work plans. All decontamination of drilling, development, and heavy equipment will be conducted within the station.

4.3.2 At a minimum, the station will be constructed such that all rinsates, liquid spray, soil, debris, and other decontamination wastes are contained as appropriate and, if necessary, may be collected for appropriate waste management and disposal. If containment is required, the station may be as simple as a bermed, impermeable polyethylene sheeting of sufficient thickness. More sophisticated designs involving self-contained metal decontamination pads in combination with bermed polyethylene sheeting may also be used, depending on project-specific requirements. These requirements along with specific equipment and construction specifications for the decontamination station will be provided in the project work plans.

4.4 Decontamination of Downhole Equipment

4.4.1 All downhole drilling and development equipment (including but not limited to drill pipe, drive casing, drill rods, bits, tools, bailers, etc.) will be thoroughly decontaminated before mobilization onto each site and between borings or wells at each site or as required in the project work plans. Decontamination will be performed in accordance with this SOP and the project work plans. The standard procedure will be performed as described below.

4.4.2 Appropriate personal protective equipment (as specified in the project work plans) must be worn by all personnel involved with the task to limit personal exposure.

4.4.3 Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed.

4.4.4 Equipment will then be sprayed with potable water.

4.4.5 Washed equipment will then be rinsed with potable water.

4.4.6 Decontaminated downhole equipment (such as drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting to prevent contact with contaminated soil and allowed to air dry. If equipment is not used immediately, it may be covered or wrapped in plastic sheeting to minimize airborne contamination.

4.4.7 Decontamination activities will be documented by the Site Superintendent, lead geologist, or lead engineer on the FADL and/or appropriate form(s), as specified in the project work plans.

4.5 Decontamination of Heavy Equipment

4.5.1 Heavy equipment (e.g., drill rigs, development rigs, backhoes, and other earthmoving equipment) will be decontaminated between drilling sites or inside the contaminant reduction area prior to entering and leaving an exclusion zone. Decontamination will be performed in accordance with this SOP and the project work plans. The standard procedure will be performed as described below.

- Appropriate personal protective equipment (as specified in the project work plans) will be worn by all personnel involved in the task, in order to limit personal exposure.
- Equipment caked with drill cuttings, soil, or other material will be initially scraped or brushed.
- Equipment will then be sprayed with potable water.
- Clean equipment will then be rinsed with potable water.

4.5.2 During the decontamination effort, fluid systems should be inspected for any leaks or problems that might potentially result in an inadvertent release at the site, thereby contributing to the volume of waste or contamination. Any identified problems should be immediately repaired and documented on the FADL. Decontamination should then be completed before moving the equipment onto the site or exclusion zone.

4.5.3 Decontamination activities will be documented by the Site Coordinator, lead geologist, or lead engineer on the FADL and/or appropriate form(s), as specified in the project work plans.

4.5.4 Between boreholes at the same site, the back-end of the drilling rigs will be washed with potable water until surfaces are visibly free of soil buildup.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form

SURFACE AND SUBSURFACE GEOPHYSICS

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for acquiring surface geophysical data. This includes the direct use of surface geophysical equipment by contractor personnel themselves, or the supervision of subcontractors conducting surface geophysical surveys. Additional specific surface geophysical procedures and requirements will be provided in the project work plans.

Surface geophysical surveys image into the subsurface using measuring equipment that is placed or located upon or above the ground surface. Common applications of surface geophysics for environmental projects include utility clearance, buried waste delineation, plume delineation, and geologic or hydrologic characterization. The most common surface geophysical techniques used for environmental applications and therefore, covered in this SOP, include: electrical resistivity, seismic refraction, electromagnetics (EM), ground penetrating radar (GPR), metal detectors, and magnetometry.

2.0 REFERENCES

2.1 SQP 4.2 - Records Management

3.0 DEFINITIONS

3.1 Electromagnetic Induction (EM or EMI)

A method of sending electromagnetic waves into the ground and measuring the responding secondary electromagnetic wave. The secondary wave is generated in the proportion to the conductivity of the earth or objects therein. EM may be used to reveal utility lines, buried waste dumps, former excavations, and in some specific cases, changes in groundwater conductivity.

3.2 Ground Penetrating Radar

A method utilizing radar waves generated and propagated into the ground surface. The reflected (backscattered) waves are received back as data. GPR is typically used to reveal buried manmade objects, such as tanks, pipes, drums, etc. It may also at times be used to delineate backfilled excavations and waste cells.

3.3 Magnetic Survey

The process of accurately measuring the earth's magnetic field (on the order of 10/50,000 of the total field). The survey reveals magnetic anomalies that may result from buried metal objects or rock-type differences.

3.4 Metal Detector

An EM tool with a specialized sensor to detect metallic objects.

3.5 Resistivity Survey

A geophysical method of determining the resistivity of the earth's layers. The survey is conducted by inducing electrical currents into the subsurface and measuring electrical potential differences at points of secondary electrical fields generated in the earth in response to the input of electrical current. Resistivity surveys are typically used to provide information on subsurface lithologies and, in certain instances, plume distributions.

3.6 Seismic Methods

Seismic surveys are conducted by inducing seismic (acoustic) waves into the ground and recording the arrival times at varying distances of the reflected or refracted waves. They are typically used to reveal buried geologic structures and contacts between rock units.

4.0 PROCEDURE

This section contains responsibilities, requirements and procedures for conducting surface geophysical surveys. Selection and design of the geophysical surveys to be used on a site must be based upon several factors. These include, but are not limited to, the following:

- Specific objectives or anticipated use of the survey (e.g., surface clearance, buried object identification, waste cell delineation, etc.);
- Known or expected site-specific conditions;
- Targeted parameters and overall surface areas to be evaluated;
- Potential site-induced effects which may limit specific survey methods; and,
- Applicability of specific survey methods in meeting above objectives given the site-induced effects.

Consequently these factors must be considered and the tests designed well before generation of the project work plans and implementation in the field. The project work plans will specify all necessary details to complete the geophysical surveys at a particular site. Surface geophysical survey information and specifications to be included in the project work plans will include, at a minimum, the following:

- Objectives of the surveys;
- Type(s) of surveys to be conducted;
- Equipment to be used;
- Lay-outs of survey grids at each site or location, including sample point spacing;
- Type, duration and frequency of measurements to be made; and,
- Additional procedures or requirements beyond those covered in this SOP.

Subcontracted geophysical surveys will also be directed by specifications defined in Statements of Work for sub-contractor services, as well as the project work plans.

At a minimum the requirements, responsibilities and procedures described in the following section must be incorporated into the surface geophysical activities to be conducted at each site.

4.1 Responsibilities

4.1.1 The Project Manager/Field Coordinator is responsible for ensuring that all surface geophysical activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to surface geophysics requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to surface geophysical activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 General Requirements

The following requirements apply to all surface geophysical surveys and should be performed as required by the project work plans and the conditions present at each survey site.

4.2.1 Inspect all equipment and supplies to ensure that they are in proper working order, using the equipment manuals provided by the equipment manufacturer.

4.2.2 Assure that annual calibration/service by the manufacturer has been conducted as recommended by the manufacturer. Calibration/service records should be maintained in the office where the instrument is stored between investigations. A copy of the calibration records should be kept with the equipment at all times. More frequent calibration/services may be necessary if field measurements indicate possible instrument malfunction.

4.2.3 Prior to mobilization to the site, conduct appropriate decontamination as and if required by the project work plans.

4.2.4 Perform field calibration checks where required by instrument manufacturer or the project work plans. Perform calibration (accuracy and reproducibility) checks in accordance with manufacturer's specifications or the project work plans.

The calibration checks should be entered on a Test Equipment Calibration Log Book or other document as specified in the project work plans. At a minimum, this document should contain the following information:

- Make and model number of the geophysical instrument;
- Serial number of the instrument;
- The date and time of calibration or instrument check;
- All calibration or instrument check measurements; and,
- The name and signature of the person conducting the calibration or instrument check.

4.2.5 Establish grid and stake locations or set up traverses for locations of sampling stations as necessary.

4.2.6 Make sure all survey or sampling locations are properly staked and the location ID is readily visible on the location stake.

4.2.7 Include a diagram of the measurement locations with the data records on a daily basis. The diagram should include grid alignment, station numbering (if used), and base station location(s).

4.2.8 At the termination of each survey, ensure that all equipment is accounted for and decontaminated as required by project work plans.

4.2.9 Any unusual conditions or problems encountered during the survey must be recorded on the Field Activity Daily Log (SOP 1.1) and brought to the attention of the Site Superintendent.

4.2.10 When the activity is completed, or at the end of the day, return the instrument(s) to a secure area. Equipment requiring electrical charging should be placed on charge.

4.2.11 It is recommended that surface geophysical survey data be stored on diskette for retrieval and management. The following information should be included for each stored data field:

- Site Location;
- Location ID (or station);
- Date; and,
- Time.

Base station values and calibration measurements do not necessarily need to be recorded on the diskette. However, they must accompany the diskette record in paper copy.

4.3 Surface Geophysical Surveying

4.3.1 Electrical Resistivity **-** The electrical resistivity method uses an instrument to measure the apparent electrical resistivity of the subsurface. This includes the underlying soil, rock, and groundwater. An electrical current is introduced into the ground through surface electrodes. The resulting potential field (voltage) is measured at the surface between a second pair of electrodes. The procedure below requires the following elements, in addition to the general requirements listed in Section 4.2.

- Set up and operate the geophysical electrical resistivity instrument according to manufacturers operating instructions. Record the readings and other pertinent information on the appropriate forms per the project work plans.
- Calculate apparent resistivities and review plots in the field as a means of quality control. Sounding curves should be relatively smooth. Abrupt changes commonly occur in sounding and profiling data. Unwanted noise may be caused by near-surface inhomogeneities, electrode contact problems, or changes in hydrogeology. Any changes or noise should be identified. Corrective actions may be taken and the survey re-run if significant improvement to the survey may be attained.
- Identified noise problems, corrective actions taken, and re-runs should be noted in the FADL (SOP 1.1).

4.3.2 Seismic Refraction **-** Seismic refraction techniques use instruments to determine the travel time or velocity of seismic waves within layers and interpret the thickness and depth of geologic units and other subsurface features. Other potential applications include the location of the water table and definition of burial pits and trenches. The procedure below requires the following elements, in addition to the general requirements listed in Section 4.2.

- Verify that factory maintenance and calibration has been conducted as recommended by the equipment manufacturer. Manufacturer maintenance should include the electronic calibration of the seismograph timing circuits.
- Check the seismic signal and noise conditions on the instrument display to verify the proper functioning of the source geophones and trigger cables.
- If possible, obtain or install boring logs before the survey in order to detect hidden layers or velocity inversions.
- Set up and operate the geophysical seismic refraction instrument according to operating instructions supplied by the manufacturer. Record the readings and other pertinent information on the appropriate forms.
- Where possible, collect seismic data where known geologic information is available to establish background responses. This information is useful for evaluating complex site conditions.

- Make a hard copy of the data if the data output is on paper records.
- In cases where paper records are not produced, plot arrival time picks made from the electronic display on a time/distance graph in the field. Problems with improper picks are often discovered through an early inspection of these plots.
- Review all output and records of the survey, identifying any potential problems requiring corrective actions.
- Implement corrections and re-run the survey as appropriate and if significant improvement to the survey may be attained.
- Any identified problems, corrective actions taken, and re-runs should be noted in the FADL (SOP 1.1).

4.3.3 Electromagnetics **-** The EM survey detects lateral and vertical variations of electrical conductivity in the subsurface environment. EM is used for the assessment of hydrogeologic conditions, and identification and mapping of contaminant plumes, trench boundaries, buried conductive wastes, steel drums, and metallic utility lines. The procedure below requires the following elements, in addition to the general requirements listed in Section 4.2.

- Establish a local standard site in the field. This will provide a reference base station to check the instrument's performance and allow correlation between instruments.
- Check the signal and noise conditions on the instrument display to verify proper functioning and assure the correct setting of the instrument.
- Before conducting the survey, select a temporary site on location for daily base station measurements and calibration checks. Calibration checks should be made twice daily, before and after conducting daily survey operations.

  Note: Do not make calibration checks in the presence of sources of cultural interference like power lines or buried utilities. Make them on a relatively flat surface outside of topographic lows and away from areas that may include subsurface waste materials.
- Operate the EM instrument according to operating instructions supplied by the manufacturer. Record instrument sensitivity settings, readings and all other pertinent information on the appropriate forms. When using an automatic recording device, enter the readings from the first and last stations of each traverse. Compare these data to data from the automatic recorder at the end of each day. Recorded data and field transcribed data must agree to within ±5 percent to meet acceptability requirements.
- Instrument stability should be checked by the field operating party when there is local or distant thunderstorm activity. Electromagnetic radiation from thunderstorms can generate noise in the EM system. Operations may have to be postponed during thunderstorms.

- Review all output and records of the survey, identifying any potential problems requiring corrective actions.
- Implement corrections and re-run the survey as appropriate and if significant improvement to the survey may be attained.
- Any identified problems, corrective actions taken, and re-runs should be noted in the FADL (SOP 1.1).

4.3.4 Ground Penetrating Radar **-** GPR uses high frequency radio waves to acquire subsurface information. The method produces a continuous cross-sectional image or profile of shallow subsurface conditions. The procedure below requires the following elements in addition to the general requirements listed in Section 4.2.

Calibration and calibration checks of the radar system requires the process described below:

- Accurately determine the total time window (range) set by the operator.
- Determine or estimate the electromagnetic velocity (or travel time) of the local soil/rock condition.
- Calibrate the time window picked for the survey by using a signal calibrator in the field. This device is used to produce a series of time marks on the graphic display measured in nanoseconds. These pulses are counted to determine the total time of the radar unit. A calibration curve can be designed for each radar system.
- If possible, use known trenches, buried pipes, and road culverts to provide a radar target of known depth. The depth of a known target, a radar record taken over the known target, and a time scale provided by the signal calibrator will provide a basic calibration record. From these data, a velocity can be accurately determined at the given target location from the following equation:

$$V=2d/t$$

The average dielectric constant of the soil is then calculated using

$$Er = c^2 / v_1^2 = 1 / v_2^2$$

where:

v_1	=	Average electromagnetic wave velocity, feet/nanosecond
t	=	Two-way travel time, nanoseconds
d	=	Distance of antenna to the buried object, feet
Er	=	Average relative dielectric constant of the soil (unitless)
c	=	Velocity of light in air equal to 1 foot/nanosecond
v_2	=	Average electromagnetic wave velocity of the soil, feet/nanosecond

Note: The above assumes a soil with a relative magnetic permeability of 1 (unitless). If significant changes in soil type or moisture content occur with depth, velocity will not be the same throughout the vertical radar profile. Therefore, the vertical radar depth scale will be nonlinear.

This approach will provide calibration at a specific site, however, this assumes that conditions in other areas are the same as the calibration area. Calibration should be repeated at each new site:

- Repeat a short GPR traverse twice daily over a known feature before and after conducting daily operations to insure that readings are caused by changing soil conditions, rather than the electronics.
- Conduct the GPR traverse at the sites or locations specified in the project work plans.
- Record calibration, instrument settings, measurements and all other pertinent information on the appropriate forms.
- Print out and review all hardcopies and records of the survey, identifying any potential problems requiring corrective actions.
- Implement corrections and re-run the survey as appropriate and if significant improvement to the survey may be attained.
- Any identified problems, corrective actions taken, and re-runs should be noted in the FADL (SOP 1.1).

4.3.5 Metal Detection **-** Metal detectors are electromagnetic devices designed to locate metallic objects buried near the surface. In hazardous waste site investigations, metal detectors are invaluable for detecting utility lines, survey markers, steel drums buried at shallow depths, and delineating areas that may potentially include metallic waste materials.

Metal detectors respond to nearby metallic objects in a relative way. For instance, closer or large metallic objects create a greater output level than more distant or smaller ones. An experienced operator can usually make a reasonably accurate estimate of target size and depth. Metal detection survey requirements, at a minimum, include:

- Set up and operate the metal detector according to operating instructions supplied by the manufacturer.
- Record the readings and all other pertinent information on the appropriate forms as outlined in the project work plans.
- Review all data and records of the survey, identifying any potential problems requiring corrective actions.
- Implement corrections and re-run the survey as appropriate and if significant improvement to the survey may be attained.
- Any identified problems, corrective actions taken, and re-runs should be noted in the FADL (SOP 1.1).

4.3.6 Magnetometer **-** Magnetometer surveys are used to locate metallic objects buried near the surface such as well casings, utility lines, steel drums, and tanks. They may also be used to delineate trenches and landfills. Ferrous metal objects carried by the operator will have a detrimental effect on the accuracy of the magnetometer data. Therefore, metal items like rings, watches, belt buckles, coins, and steel-toed boots should not be worn by the survey team.

Total field and vertical field measurements may be corrected for the diurnal variation of the earth's magnetic field by employing a reference base station magnetometer. Changes in the earth's field are removed by adding or subtracting variations of fixed base station readings from the moving survey data. Gradiometers do not require the use of a base station because they inherently eliminate time variation in the data. Requirements are as follows:

- Conduct a swing sensor test with the proton precision magnetometer before initiating operations at a site and at least once more during the day. Four readings with the sensor oriented 90° to the other readings should be taken with the operator moving with the sensor. Variations greater than one gamma should not be observed. Correct any directional bias by washing the sensor with ordinary soap and water and maintaining an adequate distance between the sensors and battery pack.
- Obtain a daily background reading in the immediate vicinity of the site to be surveyed. This reading should be outside the influence of all possible sources of cultural magnetic fields (e.g., power lines or pipelines). This daily background reading should repeat to within reasonable diurnal variations in the earth's magnetic field.
- Take base station readings to remove the effects of the diurnal variation of the earth's magnetic field from the data as outlined in the project work plans. Periods of rapid variation may be documented at a permanent base station, set up at the site, where continuous readings are automatically recorded approximately every 10 to 15 minutes. Alternatively, a base station(s) may be reoccupied during the survey at intervals of 45 to 60 minutes.
- Collect survey data and record on the appropriate form per the project work plans. Site locations influenced by cultural magnetic fields should be recorded in the logbook. Take three to four sequential readings and record time when recording data manually. In the absence of magnetic storms, the readings should compare within several tenths of a gamma. Repeatability during magnetic storms may degrade to one gamma or more.
- The use of automatic recording magnetometers requires recording the magnetometer readings for the first and last station of each traverse in a logbook. Compare the data recorded in the logbook with data from the automatic recording device. Data recorded in the logbook should be within one gamma of the values derived from the recording device.
- During cold weather, maintain the battery pack for a fluxgate magnetometer at a relatively warm temperature. This is most easily accomplished by surveying with the battery pack beneath the operator's coat or jacket.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be maintained in the Project Records file in accordance with SQP No. 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

MONITORING WELL INSTALLATION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) provides procedures and requirements for the installation of monitoring wells using rotary, dual-tube percussion, or hollow-stem auger drilling techniques. The details within this SOP should be used in conjunction with specific project work plans.

2.0 REFERENCES

2.1 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.2 *SOP 6.2 - Drilling and Heavy Equipment Decontamination*

2.3 *SOP 14.1 - Hollow Stem Auger Drilling*

2.4 *SOP 14.2 - Mud Rotary Drilling*

2.5 *SOP 14.3 - Air Rotary Drilling*

2.6 *SOP 14.4 - Dual Tube Percussion Drilling*

2.7 *SOP 15.1 - Lithologic Logging*

2.8 *SOP 16.1 - Filter Pack and Well Screen Slot Size Determination*

2.9 *SQP 4.2 - Records Management*

2.10 *SQP 8.2 - Calibration and Maintenance of Measuring and Test Equipment*

2.11 *U.S. Environmental Protection Agency (EPA), Manual of Water Well Construction Practices, U.S. Environmental Protection Agency, Office of Water Supply, U.S. Government Printing Office, Washington D.C.*

2.12 *U.S. Environmental Protection Agency (EPA), 1986, Resource Conservation and Recovery Act (RCRA) Ground Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, U.S. Government Printing Office, Washington D.C.*

2.13 *U.S. Environmental Protection Agency (EPA), 1987, A Compendium of Superfund Field Operations Methods, EPA-500/P-87/001, U.S. Government Printing Office, Washington D.C.*

3.0 DEFINITIONS

3.1 Cuttings

Pieces of soil, sediment, or rock cut by a bit in the process of drilling borings.

3.2 Borehole

Any hole drilled into the subsurface for the purpose of identifying lithology, collecting soil samples, and/or installing groundwater wells.

3.3 Grout

For the purposes of this SOP, the term "grout" consists of a neat cement grout generally containing three to five percent bentonite powder to water by weight. The grout is emplaced as a slurry, and once properly set and cured, is capable of restricting movement of water.

3.4 Hollow-Stem Auger Drilling

A drilling method using augers with open centers. The augers are advanced with a screwing or rotating motion into the ground. Cuttings are brought to the surface by the rotating action of the augers, thereby clearing the borehole.

3.5 Air Rotary Casing Hammer Drilling

A drilling method using a nonrotating drive casing that is advanced simultaneously with a slightly smaller diameter rotary bit attached to a string of drill pipe. The drive casing is a heavy-walled, threaded pipe that allows for pass-through of the rotary drill bit inside the center of the casing. Air is forced down through the center drill pipe to the bit, and then upward through the space between the drive casing and the drill pipe. The upward return stream removes cuttings from the bottom of the borehole.

3.6 Mud Rotary Drilling

For the purposes of this monitoring well installation SOP, the term "mud rotary drilling" refers to direct circulation (as opposed to reverse circulation) mud rotary drilling. Mud rotary drilling uses a rotating drill bit which is attached to the lower end of a string of drill pipe. Drilling mud is pumped down through the inside of the drill pipe and out through the bit. The mud then flows upward in the annular space between the borehole and the drill pipe, carrying the cuttings in suspension to the surface.

3.7 Dual-tube Percussion Drilling

A drilling method using nonrotating drive casing with a bit on the bottom of the casing string. A smaller diameter tube or drill pipe is positioned inside the drive casing. The drive casing is advanced by the use of a percussion hammer, thereby causing the bit to cut or break up the sediment or soil at the bottom of the boring. Air is forced down the annular space between the drive casing and inner drill pipe, and cuttings are forced up the center of the inner drill pipe.

3.8 Monitoring Well

A well that provides for the collection of representative groundwater samples, the detection and collection of representative light and dense non-aqueous phase organic liquids, and the measurement of fluid levels.

3.9 Annular Space

The space between:

- Concentric drill pipes;
- An inner drill pipe and outer drive casing;
- Drill pipe or drive casing and the borehole wall; or
- Well screen or casing and the borehole wall.

3.10 Filter Pack

Granular filter material (sand, gravel, etc.) placed in the annular space between the well screen and the borehole to increase the effective diameter of the well and prevent fine-grained material from entering the well.

3.11 Well Screen

A perforated, wire wound, continuous wrap or slotted casing segment used in a well to maximize the entry of water from the producing zone and to minimize the entrance of sand.

3.12 Tremie

A tubular device or pipe used to place grout, bentonite, or filter pack in the annular space.

4.0 PROCEDURE

This section contains both main responsibilities and procedures for monitoring well installation activities. The procedures described herein are applicable as requirements for monitoring well installations using mud rotary, air rotary, air rotary casing hammer, dual tube percussion, or hollow-stem auger drilling techniques. Site-specific factors need to be considered in the selection of well construction and completion materials, specification of well designs, and choosing well drilling methods. These factors will be incorporated in project planning activities and the compilation of specific project work plans. The project work plans will contain the following information related to monitoring well installation:

- Objectives of the monitoring well;
- Specific location of the well to be installed;
- Zone or depth well is to be installed;
- Drilling method(s) to be used;
- Well construction materials to be used;
- Specification of anticipated well design(s) ; and,
- Additional procedures or requirements beyond this SOP.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all monitoring well installation activities are conducted and documented in accordance with this and any other appropriate procedures. This will be accomplished through staff training and by quality assurance/quality control (QA/QC) monitoring activities.

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of well installation activities to assure implementation of this SOP. The PQAS is also responsible for the review and approval of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to monitoring well installation requirements, issuing nonconformances, etc.) identified during the performance of these activities.

4.1.3 Field personnel assigned to monitoring well installation activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator, Project Manager, or the PQAS.

4.2 Well Installation Procedures

4.2.1 Before mobilization of a rig to the well site, ensure that the monitoring well location has been appropriately cleared of all underground utilities and buried objects, and drill permits have been issued per the project work plans. Review all forms and diagrams documenting the location of the cleared monitoring well site and the location of any identified underground utility lines or other buried objects.

4.2.2 Decontaminate all downhole equipment and well construction materials before monitoring well installation, as described in SOP 6.1. Decontaminate the drilling rig and all drilling equipment before monitoring well installation per SOP 6.2.

4.2.3 Clear the work site of all brush and minor obstructions and then mobilize the rig to the monitoring well location. The rig geologist or engineer should then review with the driller the proposed well design and details of the well installation including any anticipated potential drilling or completion problems.

4.2.4 Calibrate health and safety monitoring equipment according to the instrument manufacturer's specifications. Document the calibration results on the appropriate form(s), as specified by SQP 8.2. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

4.2.5 Workers will be provided with, and don, the appropriate personal protective equipment as specified by the project work plans. Typically, the minimum personal protection will include a hard hat, safety glasses, gloves, steel-toed boots, hearing protection, and coveralls.

4.2.6 Commence drilling and advance the borehole while conducting health and safety monitoring according to the project work plans. Perform readings as often as necessary to ensure the safety of workers. Record all measurements on the Field Activity Daily Log (FADL) (SOP 1.1) and/or other appropriate form(s) as specified in the project work plans. Record all other pertinent information (date, site, well or boring number, and location) on the FADL and/or other appropriate form(s) as specified by the project work plans. Also note and record observed field conditions, any unusual circumstances, and weather conditions. Drilling of the borehole should be conducted in conformance with SOPs 14.1, 14.2, 14.3, or 14.4, as appropriate.

4.2.7 During drilling, collect representative cutting and soil samples as required by the project work plans. Compile a boring or lithologic log from the cuttings and samples per SOP 15.1.

4.2.8 At total depth, remove soil cuttings through circulation or rapidly spinning the augers prior to constructing the well. Review logs and notes with the driller for any zones or depths exhibiting drilling problems which may affect the well installation. Condition the hole or take other actions mutually agreed upon by the rig geologist (or engineer), lead technical personnel, and the driller to ensure or aid in the well development.

4.2.9 Remove the drill pipe and bit if using rotary techniques, or remove the center bit boring if using the hollow-stem auger technique. The well construction materials will then be installed inside the open borehole or through the center of the drive casing or augers.

4.2.10 Measure the total depth of the completed boring using a weighted sounding line. The borehole depth is checked to assure that formation material has not heaved to fill the borehole. If heaving has taken place, options for cleaning, redrilling, or installation in the open section of the boring should be discussed with lead technical personnel.

4.2.11 In the event that the hole was over-drilled, grout, bentonite pellets, or bentonite chips (as specified in the project work plans) may be added to the bottom of the boring to raise the bottom of the hole to the desired depth. The grout should be pumped through a tremie pipe and fill from the bottom of the boring upward. During grouting, the tremie pipe should be submerged below the top of the grout column in the borehole to prevent free-fall and bridging. If bentonite is used, it should be added gradually to prevent bridging. Grout or bentonite addition will stop when its level has reached approximately one foot below the desired base of the well string (casing, screen, end plug or sump, etc.). The bentonite plug will be hydrated for at least one hour before installation of a filter pack.

4.2.12 Calculate volumes of filter pack, bentonite pellets/slurry, and grout required, based on borehole and well casing dimensions. If required by the project work plans, determine the filter pack and well screen slot size for the monitoring well per SOP 16.1.

4.2.13 Place a layer of filter pack (one to two feet, unless otherwise specified in the project-specific work plans) at the bottom of the borehole. The filter pack will be installed through the center of the drive casing/augers. Filter pack will be added slowly while withdrawing the drive casing/augers.

4.2.14 Inspect the casing, screen, and any other well construction materials prior to installation to assure that no damage has occurred during shipment and decontamination activities.

4.2.15 Connect and carefully lower the well string through the open borehole, drive casing, or inside of the augers until the well string is at the desired depth. The well string should be suspended by the installation rig and should not rest on the bottom of the boring. In the event the well string was dropped, lowered abruptly, or for any other reason suspected of being damaged during placement, the string should be removed from the boring and inspected. In certain instances, the well string may rise after being placed in the borehole due to heaving sands. If this occurs, the driller must not place any drilling equipment (drill pipe, hammers, etc.) to prevent the casing from rising. The amount of rise should be noted by the rig geologist or engineer who should then consult lead technical personnel for an appropriate course of action.

4.2.16 Record the following information on the Borehole/Well Construction Log (Attachment 6.1) and/or other appropriate forms per the project work plans:

- Length of well screen;
- Total depth of well boring;
- Depth from ground surface to top of grout or bentonite plug in bottom of borehole (if present);
- Depth to base of well string; and,
- Depth to top and bottom of well screen.

4.2.17 When using the mud rotary drilling technique, tremie the filter pack into the annular space around the screen. Clean, potable water may be used to assist with the filter pack tremie operation. For all other drilling techniques, the filter pack may be allowed to free fall or be tremied per the project work plans. If using drive casing or augers, the drive casing or augers should be pulled slowly during filter pack installation in increments no greater than five feet.

4.2.18 Filter pack settlement should be monitored by initially measuring the sand level (before beginning to withdraw the drive casing/augers). In addition, depth soundings using a weighted tape shall be taken repeatedly to continually monitor the level of the sand. The top of the well casing shall also be monitored to detect any movement due to settlement or from drive casing/auger removal. If the top of the well casing moves upwards at any time during the well installation process, the driller should not be allowed to set drilling equipment (downhole hammers, drill pipe, etc.) on the top of the casing to prevent further movement.

4.2.19 Filter pack should be added until its height is approximately two feet above the top of the screen (unless otherwise specified in the project work plans), and verification of its placement (by sounding) should be conducted. The filter pack should then be gently surged using a surge block or swab in order to settle the pack material and reduce the possibility of bridging.

4.2.20 The height of the filter pack will then be re-sounded and additional filter pack placed as necessary. Once the placement of the filter pack is completed, the depth to the top of the pack is measured and recorded on the Borehole/Well Construction Log (Attachment 6.1) or other appropriate forms per the project work plans.

4.2.21 A three-foot thick (unless otherwise specified in the project work plans) bentonite seal is then installed on top of the filter pack. If pellets or chips are used, they should be added gradually to avoid bridging. Repeated depth soundings will be taken using a weighted tape to ascertain the top of the bentonite seal. The seal should be allowed to hydrate for at least one hour before proceeding with the grouting operation.

4.2.22 After hydration of the bentonite seal, grout is then pumped through a tremie pipe and filled from the top of the bentonite seal upward. The bottom of the tremie pipe should be maintained below the top of the grout to prevent free fall and bridging. When using drive casing or hollow-stem auger techniques, the drive casing/augers should be raised in incremental intervals, keeping the bottom of the drive casing/augers below the top of the grout. Grouting will cease when the grout level has risen to within approximately one to two feet of the ground surface, depending on the surface completion type (flush mount versus aboveground). Grout levels should be monitored to assure that grout taken into the formation is replaced by additional grout. If settling of the grout occurs, additional topping off of the grout may be necessary.

4.2.23 For aboveground completions, the protective steel casing will be centered on the well casing and inserted into the grouted annulus. Prior to installation, a 2-inch deep temporary spacer may be placed between the PVC well cap and the bottom of the protective casing cover to keep the protective casing from settling onto the well cap.

4.2.24 After the protective casing has set, a drainage hole may be drilled into the protective casing if required by the project work plans. The drainage hole is positioned approximately two inches above ground surface. The protective casing will be painted with a rust-preventive colored paint.

4.2.25 The well head will be labeled to identify, at a minimum, the well number, depth, and date of installation.

4.2.26 A minimum of 24 hours after grouting should elapse before installation of the concrete pad and steel guard posts for aboveground completions, or street boxes or vaults for flush mount completions.

4.2.27 For aboveground completions, a concrete pad, usually 3-foot by 3-foot by 4-inch thick, is constructed at ground surface around the protective steel casing. The concrete is sloped away from the protective casing to promote surface drainage from the well.

4.2.28 For aboveground completions, where traffic conditions warrant extra protection, three steel bucking posts may be embedded to a depth approximately 1.5 feet below the top of the concrete pad. The posts will be installed in concrete filled post holes spaced equally around the well at a distance of approximately 1.5 feet from the protective steel casing. Where removal of bucking posts is required for well access, mounting sleeves should be imbedded into the concrete.

4.2.29 For flush mount (or subgrade) completions, a street box or vault is set and cemented in position. The top of the street box or vault will be raised slightly above grade and the cement sloped to grade to promote surface drainage away from the well.

4.2.30 Following well completion and demobilization of the rig, the well site should be cleared of all debris and trash and restored to a neat and clean appearance per the project work plans. All investigation-derived waste generated at the well site should be appropriately contained and managed per the project work plans.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Borehole/Well Construction Log

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

BOREHOLE/WELL CONSTRUCTION LOG

WEISS ASSOCIATES

BOREHOLE / WELL CONSTRUCTION LOG

BOREHOLE LOCATION	Project: (facility, address, city, state)	Borehole/Well No:
		Job No:
	Logged By:	Edited By:
	Project Manager:	Drill Rig:
	Drilling Contractor: (name, city, state)	
	Driller:	License # : C57-
	Drilling Method:	Sample Method:
	Well Head Completion:	Ground Surface Elevation:
	Hammer Weight/Drop:	Borehole Diameter:
	Started, Time:	Date:
	Completed, Time:	Date:
Approximate Scale:		
Notes:		

Water Depth						
Boring/Casing Depth						
Time						
Date						

Total Boring Depth:	Total Well Depth:
Screened Interval:	Well Diameter:
Sand Pack (Type and Interval):	
Well Development Method: Time: Date: Flow Rate:	
Geophysical Logs, Type: By: Date:	

Sample ID	PID / FID (ppm)	Sampler Type / depth	Blows per 6 Inches	Inches Driven	Inches Recovered	Sample Condition	Boring Diameter	Diagram: Conductor Casing(s) Interval and Diameter	Diagram: Sand / Grout	Diagram: Well Casing / Screen	Depth in Feet	Recovery / Sample Loc.	Contact / Hyd. Conduct.	LITHOLOGIC DESCRIPTIONS
											1			
											2			
											3			
											4			
											5			
											6			
											7			
											8			
											9			
											10			

WEISS ASSOCIATES

BOREHOLE / WELL CONSTRUCTION LOG (cont.)

Page____ of____

Sample ID	PID/FID	Sampler Type	Blows / 6 Inches	Inches Driven	Inches Recov'd	Sample Cond.	Boring Diameter	Conduct. Casing	Sand / Grout	Well Casing	Depth (ft)	Recovery	Contact	Project / Job No.: Borehole/Well No.: Notes:
											1			
											2			
											3			
											4			
											5			
											6			
											7			
											8			
											9			
											0			
											1			
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											7			
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											9			
											0			

MONITORING WELL DEVELOPMENT

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for specifying, assessing and documenting the well development process. Additional specific well development procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *SOP 5.1 - Water Level Measurements in Monitoring Wells*

2.2 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.3 *SOP 6.2 - Drilling and Heavy Equipment Decontamination*

2.4 *SQP 4.2 - Records Management*

2.5 *SQP 8.2 - Calibration and Maintenance of Measuring and Test Equipment*

2.6 *U.S. Environmental Protection Agency (EPA), August 1988, Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.7 *U.S. Environmental Protection Agency (EPA), 1987, A Compendium of Superfund Field Operations Methods, EPA-540/P-87/001a, U.S. Government Printing Office, Washington D.C.*

2.8 *ASTM, 1988, Standards Technology Training Program - Groundwater and Vadose Zone Monitoring, Nielsen, et al.*

3.0 DEFINITIONS

3.1 Well Development

The act of removing fine grained sediment and drilling fluids from the sand pack and formation in the immediate vicinity of the well, thus increasing the porosity and permeability of the materials surrounding the intake portion of the well.

3.2 Educator Pipe

The pipe used to transport well discharge water to the surface.

4.0 PROCEDURE

4.1 General

4.1.1 The most common methods used to develop monitoring wells consist of surging and bailing, surging and pumping, or combinations of all these.

4.1.2 The project work plans will identify the specific well development procedure to be followed. The standard procedure for field personnel to use in assessing and documenting well development is described below and is intended only for development methods listed above.

4.2 Responsibilities

4.2.1 The Project Manager is responsible for ensuring that monitoring wells are properly developed and that the development process is properly documented in accordance with this and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.2.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with well development. If deviations from project requirements occur, the PQAS is also responsible for issuing notices of nonconformances and requests for corrective action.

4.2.3 Field personnel are responsible for conducting monitoring well development and documentation in accordance with the specifications outlined in this SOP and by the project work plans. All staff are responsible for reporting deviations from the procedures to the Field Coordinator, Project Manager, or the PQAS.

4.3 Well Development

4.3.1 Decontaminate the rig and development equipment in accordance with SOPs 6.1 and 6.2, respectively.

4.3.2 Calibrate all field analytical test equipment (pH, temperature, conductivity, turbidity) according to the instrument manufacturer's specifications and SQP 8.2. Specific test equipment to be used should be identified in the project-specific work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service, tagged with an out of calibration label, and segregated (when possible) from the calibrated equipment area.

Water level meters will be calibrated at the beginning of the project and then every six months using a steel surveyor's tape.

4.3.3 Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Any observed problems with the well head should be noted in the Field Activity Daily Log (FADL) (SOP 1.1) and reported to the Site Superintendent.

4.3.4 Unlock the well and obtain a depth to water level measurement according to the procedures outlined in SOP 5.1. Calculate the volume of water in the well (cased well volume) as follows:

$$\pi x(\frac{d}{2})^2 \text{ x } (h_1 - h_2) \text{ x } 7.48 = \text{gallons per cased well volume}$$

where:

π ≈ 3.14 (dimensionless)
d = inside diameter of well casing (in feet)
h_1 = depth of well from top of casing (in feet)
h_2 = depth to water from top of casing (in feet)

4.3.5 The depth to the bottom of the well should be sounded and then compared to the completion form or diagram for the well. If sand or sediment are present inside the well, it should first be removed by bailing. Do not insert bailers, pumps, or surge blocks into the well if obstructions, parting of the casing, or other damage to the well is suspected. Instead report the conditions to the Site Superintendent and obtain approval to continue or cease well development activities.

4.3.6 Begin development by first gently surging followed by bailing or pumping. This is then continued with alternate surging and bailing or pumping. At no time should the surge block be forced down the well if excessive resistance is encountered. During development, the bailer should not be allowed to free-fall or descend rapidly such that it becomes lodged in the casing or damages the end cap or sediment trap at the bottom of the well.

4.3.7 While developing, take periodic water level measurements (at least one every five minutes) to determine if drawdown is occurring and record the measurements on the Well Development Data form (Attachment 6.1).

4.3.8 While developing, calculate the rate at which water is being removed from the well. Record the volume on the Well Development Data form.

4.3.9 While developing, water is also periodically collected directly from the eductor pipe or bailer discharge and readings taken of the indicator parameters: pH, specific conductance, and temperature. Development is considered complete when the indicator parameters have stabilized (i.e., three consecutive pH, specific conductance, and temperature readings are within tolerances specified in the project work plans) and a minimum of three well volumes of water have been removed. In certain instances, for slow recharging wells, the parameters may not stabilize. In this case, well development is considered complete upon removal of the minimum of three well volumes. In some cases, the project work plans may also specify a maximum turbidity requirement for completion of development.

4.3.10 Obtain a water level and turbidity measurement at the completion of development.

4.3.11 Complete documentation of the well development event on the Well Development Record form. At a minimum this record must contain:

- Project name and number;
- Well identification number;
- Well depth, casing size, and completion date;
- Method of development;
- Volume of water removed;
- Water levels (including the time of measurement);
- Physical description of the water (e.g., discoloration, turbidity, odor, etc.) and solids removed from the well;
- Test equipment readings for pH, conductivity, temperature and turbidity (including the time of collection); and,
- Signature of the well development observer.

4.3.12 Collect and appropriately transport and dispose of water removed from the well in accordance with criteria listed in the project-specific work plans and regulatory requirements.

4.3.13 Allow the well to recover for at least 24 hours prior to sampling.

5.0 RECORDS

Records generated as a result of implementing this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Well Development Form

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

WELL DEVELOPMENT DATA FORM

Well Development Data

Page ____ of ____

Project Name ________________________________ Project Location ____________________________

Weather Conditions ___________________________ Job No. ____________________________________

Well ID Number ______________________________ Date _______________________________________

Development Method(s) ____ By _______________

Depth to Water Before Development (ft) _________ Reference Elevation _____________________

Well Diam. (in.) ____ Screened Interval (ft) _________________ Well Depth (ft) ________________

Time	Depth to Water (ft)	Gallons Pumped	Flow Rate (gpm)	Comments (water clarity, odor, methods, sounded depth, etc.)

Well Development Summary

Depth to Water During Pumping (ft) ____________ Approximate yield ___________________________

Depth to Water after Development ______________ Average Pumping Rate (gpm) _________________

Sounded Depth After Development _____________ Pumping Rate Range (gpm) __________________

Total Pumping Time (min) ____________________ Total H_20 Injected (gals) ______________________

Total Amount Evacuated (gals) __________________ Well Development Observer _________________

BOREHOLE AND WELL ABANDONMENT

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for field personnel to use in the supervision of borehole or soil boring abandonment and groundwater monitoring well abandonment (destruction) activities. Additional specific borehole and well abandonment procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *California Department of Water Resources (CDWR), 1981, Water Well Standards: State of California, Bulletin 74-81, December 1981*

2.2 *California Department of Water Resources (CDWR), 1988, Draft Monitoring Well Standards: State of California, Bulletin 74-88, September 1988*

2.3 *California Department of Water Resources (CDWR), 1991, Draft California Well Standards, Bulletin 74-90, June 1991*

2.4 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Borehole Abandonment

The process whereby boreholes or soil borings are grouted or sealed following completion of drilling, sampling and/or logging.

3.2 Well Abandonment

For the purposes of this SOP, "well abandonment" will refer to the abandonment of groundwater monitoring wells only. Well abandonment is the process of formally destroying the well such that it may never be used again. Well abandonment generally consists of two basic methods:

- Abandoning the well in-place; or

- Drilling the well out.

The exact type of methodology that is used at a site is dependent upon specific regulatory requirements, and may actually be negotiated with the applicable regulatory agencies.

Abandoning the well in place basically consists of cementing the sand pack, well screen and casing in place, usually with a cement bentonite grout. The grout is commonly pumped through a tremie pipe inside the well. At certain sites the regulators may require perforating the casing across low permeability zones, excess sand pack interval (i.e., behind blank casing), and/or intervals of poor cement seal (as determined from a cement bond log run inside the casing). The grouting is then conducted in successive stages across the perforated intervals. In other instances, the regulatory agencies may require in-place abandonment be conducted using pressure grouting techniques.

Drilling the well out is most commonly conducted using a hollow stem auger. In certain instances a rotary wash might also be used. The auger size is selected so that the inside diameter of the augers is slightly greater than the well casing and screen. The auger is then centered over the casing with the center plug and pilot bit removed, or a small guide plug inserted in the casing. The cement seal, bentonite seal, and sand pack is then drilled out with the augers as they are advanced or washed over the well casing and screen. Once the cement seal, bentonite seal, and sand have been drilled out and circulated to the surface, the well casing and screen are then pulled from the hole. The remaining boring is then usually sealed with a tremied cement grout.

The above methodologies also commonly incorporate the removal of the well head and surface completion materials down to a pre-specified depth. The surface is then sealed and a permanent marker or monument may also be emplaced at the surface.

Any of the above methodologies are effective in rendering the wells inoperable and preventing them from becoming conduits for enhanced vertical transport.

4.0 PROCEDURE

This section contains responsibilities, procedures and requirements for borehole and well abandonment. Abandonment procedures to be used at a particular site must incorporate project-specific regulatory requirements. Consequently, the project work plans will identify the following:

- Abandonment objectives;
- Boreholes to be abandoned;
- Monitoring wells to be abandoned;
- Applicable site-specific regulatory requirements for monitoring well abandonment; and,
- Specific procedures for borehole and well abandonment beyond those covered in this SOP.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all abandonment activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to the abandonment requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to borehole and well abandonment activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator, Project Manager or the PQAS.

4.2 Abandonment of Boreholes

After drilling, logging and/or sampling, boreholes should be backfilled by the method described in the project work plans. This typically consists of backfilling to the surface with a bentonite-cement grout.

4.2.1 Bentonite should be thoroughly mixed into the grout and within the percentage range specified in the work plans. The grout is usually tremied into the hole; however for selected boreholes (e.g., shallow borings well above the water table) at certain sites, the grout may be allowed to free fall. In either case, care must be taken to ensure the grout does not bridge, forming gaps or voids in the grout column.

4.2.2 The volume of the borehole should be calculated and compared to the grout volume used during grouting to aid in verifying that bridging did not occur.

4.2.3 When using a tremie to place grout in the borehole, the bottom of the tremie should be submerged into the grout column and withdrawn slowly as the hole fills with grout. If allowing the grout to free fall (and not using a tremie), the grout should be poured slowly into the boring. The rise of the grout column should also be visually monitored or sounded with a weighted tape.

4.2.4 If the method used to drill the boring utilized a drive casing, the casing should be slowly extracted during grouting such that the bottom of the casing does not come above the top of the grout column.

4.2.5 During the grouting process, the personnel performing the task should be supervised to assure that potentially contaminating material (oil, grease, or fuels from gloves, pumps, hoses, et. al) does not enter the grout mix and that personnel are properly wearing personal protective equipment as specified in the Project Health and Safety Plan.

4.2.6 Following grouting, barriers should be placed over grouted boreholes as the grout is likely to settle in time, creating a physical hazard. Grouted boreholes will typically require at least a second visit to "top off" the hole.

4.2.7 The surface hole condition should match the pre-drilling condition (asphalt, concrete, or smoothed flush with native surface), unless otherwise specified in the project work plans.

4.3 Pre-Abandonment Activities

The abandonment of monitoring wells should be done in compliance with applicable state and local regulations. Permits should be obtained from the county, or any other agency which requires one, prior to well abandonment.

4.3.1 For sites in California, well abandonment standards have been developed by the California Department of Water Resources (CDWR, 1981, 1988, and 1991). An abandonment report should be filed with the CDWR (DWR Form 188, Rev. 12.86). An example form is included as Attachment 6.1. The form ID numbers are unique, and an original form must be obtained from the CDWR. A supply of these forms is usually available at WA. In addition, only a California-licensed drilling contractor possessing a valid C-57 State license should be contracted to perform abandonment activities at sites in California. The California Department of Toxic Substances Control (DTSC) may also have additional abandonment requirements for sites in which they are the lead agency. In the past they have required a well abandonment workplan be compiled and approved before conducting abandonment activities.

4.3.2 Even if not required by the regulatory agencies, it is advisable to compile a well abandonment plan to be included in the project work plans for use by the well-site geologist/engineer and the driller. The procedures for the abandonment within the plan should be consistent with the above applicable regulatory requirements. The plan should be reviewed by the field crew prior to the abandonment of a well.

4.3.3 Certain information may be required to appropriately complete the plans and is important in planning and ensuring that effective abandonment of the well will be completed. This information may include the following:

- The subsurface lithology/soil types in the immediate vicinity of the well, as derived from the boring, soil core and/or borehole geophysical logs compiled from the particular well;
- The well condition information based upon historical or operations records (including sample collection forms) and previous inspection activities (e.g., tape soundings, video camera logging, borehole geophysical logging, etc.);
- The well construction information, including type and diameter of casing and well screen, and depths, composition and thicknesses of sand packs, bentonite seals and cement seals; and

- Past analytical results of groundwater samples collected from the well.

4.4 In-Place Well Abandonment Activities

This section describes basic requirements for abandoning (cementing) monitoring wells in place as discussed in Section 3.2 above.

4.4.1 Upon initiation of abandonment activities, all downhole sampling (e.g., dedicated purge pumps, sample pumps, etc.) and monitoring equipment must be removed from the well.

4.4.2 Obtain a measurement of the total depth of the well and compare to the existing well construction information. If granular material (e.g., sand pack, formation sediment, etc.) is believed present inside the well based upon the sounding, a bailer may be run to bottom to attempt to ascertain the type of debris.

4.4.3 The granular well debris should then be removed from the well by bailing, pumping or other appropriate techniques.

4.4.4 If the condition of the well casing is suspect or of concern, it may be advisable to run a video log of the well, if it has not already been done. However, judgement and caution will need to be exercised to prevent sticking the camera inside the well during the video logging.

4.4.5 If significant scaling or encrustation of the well is observed, the well should then be brushed and cleaned.

4.4.6 If perforation across low permeability zones or voids in the cements seal (as determined from a cement bond log) is required by the appropriate regulatory agency, the perforation is conducted using a perforation gun with explosive charges. The intervals to be perforated are predetermined and specified in the well abandonment or project work plans or may also be based upon field evaluation of a cement bond log run inside the well. The perforating should be conducted:

- using either wireline or tubing conveyed guns;
- by an experienced driller or wireline company; and,
- following all applicable requirements of the Project and/or Site-Specific Health and Safety Plan.

4.4.7 A mills knife may also potentially be used instead of a perforation gun if the well conditions are conducive to its use (e.g., where no cement seal exists behind the casing).

4.4.8 Upon completion of the perforating, the screen interval and sand pack is then grouted with cement grout. The type and composition of the grout mixture will be specified in the abandonment and/or project work plans. The grout will be emplaced as required by the abandonment and/or project work plans.

4.4.9 The remainder of the well casing and the perforated intervals are then grouted in successive stages as specified in the abandonment and/or project work plans.

4.4.10 If the well is abandoned in-place without perforating, the well is sealed with cement grout after any necessary brushing and cleaning (see Section 4.3.2.5). The type and composition of the grout mixture will be specified in the abandonment and/or project work plans. If tremieing is required, the grout should be pumped via a tremie pipe or equivalent placed near the bottom of the well with the tremie pipe or equivalent progressively removed as grouting progresses.

4.4.11 In all cases while grouting the well, special care should be used to restrict the flow of groundwater into the well if subsurface pressure producing the flow is significant. During the grouting process, the personnel performing the task should be supervised to assure that potentially contaminating material (oil, grease, or fuels from gloves, pumps, hoses, et. al) does not enter the grout mix and that personnel are properly wearing personal protective equipment as specified in the Project Health and Safety Plan.

4.4.12 Quantities of grout used are to be recorded on a Field Activity Daily Log (FADL) (SOP 1.1). It should be verified that the volume of the grout placed during destruction operations equals or exceeds the volume to be filled and sealed. This is to help determine whether the well has been properly destroyed and that no jamming or bridging of the grout has occurred.

4.4.13 The final well surface disposition should be completed as stated in the abandonment and/or project work plans.

4.4.14 Any problems or unusual conditions observed during the entire abandonment process should be recorded on the FADL (SOP 1.1). A Well Abandonment Log (Attachment 6.2) should also be completed for the well during and upon completion of abandonment activities to provide appropriate documentation.

4.5 Well Removal Abandonment Activities

This section describes basic requirements for monitoring well abandonment by drilling the well out. As hollow-stem auger drilling techniques are most commonly employed, they will be described in this section.

4.5.1 Upon initiation of abandonment, conduct equipment and debris removal activities.

4.5.2 If the condition of the well casing or screen is suspect (e.g. parting is suspected), a video log may be run inside the well. If parting of the casing or screen is evident, drilling the well out may not be feasible and abandoning the well in-place may need to be considered as a more viable option.

4.5.3 For drilling out the well, the site should be prepared and the rig centered over the well per the project work plans and appropriate drilling method SOPs. The lead auger is positioned such that it will wash over the well casing during drilling. A small guide plug may then be positioned through the inside of the auger and into the casing.

4.5.4 The cement seal and sand pack are then drilled out by advancing the augers and adding auger joints to the drill string. Drilling should be conducted following procedures specified in applicable drilling method SOPs and the project work plans.

4.5.5 Once the targeted total depth is reached, the hole is cleaned by circulating out all cement, sand pack and cuttings by spinning the augers.

4.5.6 The well casing is then removed using casing jacks, drill line or other appropriate methods. If the casing is disconnected during removal, it is advisable to suspend and hold the casing with slips. Care should be taken to prevent the remaining casing from falling back into the hole.

4.5.7 The remaining boring is then sealed following procedures specified in Section 4.2 and the abandonment and/or project work plans.

4.5.8 The final well surface disposition should be completed as stated in the abandonment and/or project work plans.

4.5.9 Any problems or unusual conditions observed during the entire abandonment process should be recorded on the FADL (SOP 1.1). A Well Abandonment Log (Attachment 6.2) should also be completed for the well during and upon completion of abandonment activities to provide appropriate documentation.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be maintained in the Project Records file in accordance with SQP No. 4.2.

6.0 ATTACHMENTS

6.1 DWR Form 188, Rev. 12.86 (example only)

6.2 Well Abandonment Log

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

DWR FORM 188, REV. 12.86 (EXAMPLE ONLY)

ATTACHMENT 6.1
DWR FORM 188, REV.12-86

- EXAMPLE ONLY —

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

Do not fill in

No. 327297

Notice of Intent No. ____
Local Permit No. or Date ____

State Well No. ____
Other Well No. ____

(1) OWNER: Name ____
Address ____
City ____ ZIP ____

(2) LOCATION OF WELL (See instructions):
County ____ Owner's Well Number ____
Well address if different from above ____
Township ____ Range ____ Section ____
Distance from cities, roads, railroads, fences, etc. ____

WELL LOCATION SKETCH

(3) TYPE OF WORK.
New Well ☐ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☐
(Describe)

(5) EQUIPMENT.
Rotary ☐ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK.
Yes ☐ No ☐ Size ____
Diameter of bore ____
Packed from ____ to ____ ft.

(7) CASING INSTALLED.
Steel ☐ Plastic ☐ Concrete ☐

(8) PERFORATIONS
Type of perforation or size of screen ____

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size

(9) WELL SEAL.
Was surface sanitary seal provided? Yes ☐ No ☐ If yes, to depth ____ ft.
Were strata sealed against pollution? Yes ☐ No ☐ Interval ____ ft.
Method of sealing ____

(10) WATER LEVELS:
Depth of first water, if known ____ ft.
Standing level after well completion ____ ft.

(11) WELL TESTS:
Was well test made? Yes ☐ No ☐ If yes, by whom? ____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test ____ ft. At end of test ____ ft.
Discharge ____ gal/min after ____ hours Water temperature ____
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? ____
Was electric log made? Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth ____ ft. Completed depth ____ ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
–		

Work started ____ 19__ Completed ____ 19__

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief

Signed ____
(Well Driller)
NAME ____
(Person, firm, or corporation) (Typed or printed)
Address ____
City ____ ZIP ____
License No. ____ Date of this report ____

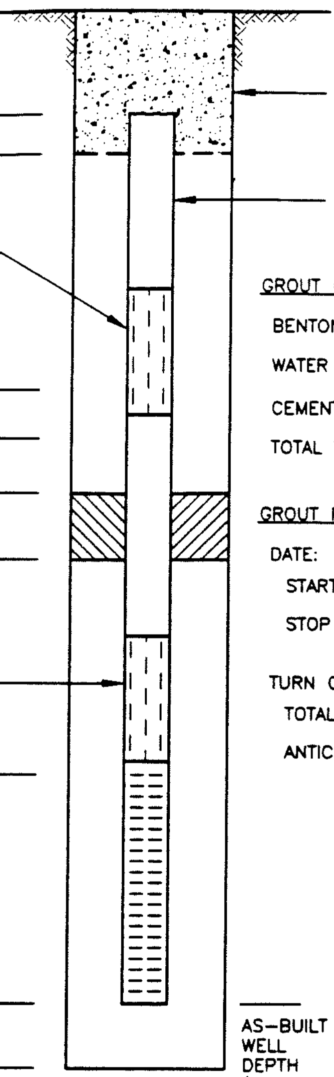
DWR 188 (REV. 12-86)

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ATTACHMENT 6.2

WELL ABANDONMENT LOG

ATTACHMENT 6.2
WELL ABANDONMENT LOG



GROUT MIXTURE — VOLUME ESTIMATED:

	MIX I	MIX II	MIX III
BENTONITE (lbs.)			
WATER (gal.)			
CEMENT (bags X $\frac{94 \text{ bags}}{\text{bag}}$)			
TOTAL VOLUME (gal.)			

GROUT PUMPED		GALLONS
DATE:		
START TIME	________	________
STOP TIME	________	________

TURN OFF TIME:

TOTAL VOLUME USED:

ANTICIPATED VOLUME (CALCULATED):

PERFORATION ZONES	TOTAL PERFORATIONS PER ZONE (TWO PER FOOT)
________	________
________	________
________	________
________	________

TOTAL PERFORATIONS: ________

NOTES:

WELL ABANDONMENT COMPLETED:

RIG GEOLOGIST/ENGINEER ____________ DATE ________

FD-WADIA(FD1)

LOW-FLOW GROUND WATER SAMPLING WITH DEDICATED PUMPS

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the collection and documentation of low-flow ground water samples for chemical analysis. Proper collection procedures are necessary to assure the quality and integrity of all ground water samples. Additional specific procedures and requirements will be provided in the project work plans, as necessary.

2.0 REFERENCES

2.1 EPA, April 1996, Ground Water Issue, Low-Flow (Minimal Drawdown)Ground-Water Sampling Procedures, EPA/540/S-95/504

2.1 2.2 EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14

2.2 2.3 EPA, August 1988, EPA Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, Interim Final OSWER Directive 9355.3-01

2.3 2.4 ASTM, 1988, Standards Technology Training Program – Ground Water and Vadose Zone Monitoring, Nielsen, et al.

2.4 2.5 SOP 1.1 - Chain-of-Custody

2.5 2.6 SOP 2.1 - Sample Handling, Packaging and Shipping

2.6 2.7 SOP 5.1 - Water Level Measurements in Monitoring Wells

2.7 2.8 SOP 6.1 - Sampling Equipment and Well Material Decontamination

2.8 2.9 SOP 17.1 - Sample Labeling

2.9 2.10 SOP 17.2 - Sample Numbering

~~2.10~~2.11 *SOP 19.1 - On-Site Sample Storage*

~~2.11~~2.12 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Bladder Pump

A bladder pump is an enclosed cylindrical tube containing a flexible membrane bladder. Well water enters the bladder through a one-way check-valve at the bottom. Gas is forced into the annular space (positive displacement) surrounding the bladder through a gas supply line. The gas displaces the well water through a one-way check-valve at the top. The water is brought to the surface through a water discharge line. Gas (air or nitrogen) is provided by compressors or cylinders.

~~*3.2 Peristaltic Pump*~~

~~A peristaltic pump is a self-priming, low volume pump consisting of a rotor and ball bearing rollers. Tubing placed around the rotors is squeezed by the rotors as they revolve. The squeezing produces a wavelike contractual movement which causes water to be drawn through the tubing. The peristaltic pump is limited to sampling at depths of less than 25 feet.~~

~~*3.3 Electric Submersible Pump*~~

~~An electric submersible pump is an enclosed cylindrical tube containing a motor with rotary attachments. Well water enters the cylinder through a one-way check valve. Electrical power to the motor causes rotors or impellers to turn and displace the ground water.~~

~~*3.4 Bailer*~~

~~A bailer is an enclosed cylindrical tube containing a floating ball check valve at the bottom. Lowering the bailer into water causes the ball to float, allowing water to enter the cylinder. Raising the bailer through the water causes the ball to settle, creating a seal to trap the water so that it can be brought to the surface.~~

~~3.5~~3.2 Dedicated Ground Water Monitoring Equipment

Dedicated ground water monitoring equipment is used to purge and sample only one well. The equipment is installed and remains in the well for the duration of the monitoring program. Dedicated equipment does not need to be decontaminated between sampling events.

4.0 PROCEDURE

This section contains both the responsibilities and procedures involved with low-flow ground water sampling. Proper ground water sampling procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with project work plans. The project work plans will generally provide the following information:

- Sample collection objectives;
- Locations of ground water samples to be collected;
- Numbers and volumes of samples to be collected;
- Types of chemical analyses to be conducted for the samples;
- Specific quality control (QC) procedures and sampling required; and,
- Any additional ground water sampling requirements or procedures beyond those covered in this SOP, as necessary.
- At a minimum, the procedures outlined in this SOP for ground water sampling will be followed.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QC/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to ground water sampling activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Field Coordinator, Project Manager or the PQAS.

4.2 Ground Water Sampling Requirements

4.2.1 Equipment Selection and Sampling Considerations

Purging and sampling equipment is constructed from a variety of materials. The most inert material (e.g., Teflon, stainless steel), with respect to known or anticipated contaminants in the well(s), should be used whenever possible. The project work plans will describe the type of equipment to be used.

~~If non-dedicated sampling is to be used and the contaminant histories of the wells are known, it is advisable to establish a sampling order starting with the least contaminated well and progressing to the most contaminated last.~~

4.2.2 Ground Water Purging and Sampling with a Dedicated Bladder Pump

Pre-sample purging and sampling will be conducted in accordance with the project work plans. The standard procedure for ground water purging and sampling using a bladder pump is described below.

a. Inspect the equipment to ensure that it is in good working order.

b. Calibrate all field analytical test equipment (e.g., pH, temperature, conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity) according to the instrument manufacturer's specifications. Calibration results will be recorded on the appropriate form(s) as specified by the project work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

Water level meters will be calibrated at the beginning of the project and then every six months using a steel surveyor's tape.

c. If non-dedicated equipment is being used, decontaminate according to SOP 6.1. During decontamination, the equipment should again be inspected for damage and, if present, repaired or replaced with undamaged equipment.

d. c. Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Damage or other conditions that may affect the integrity of the well will be recorded on the Field Activity Daily Log (SOP 1.1) and brought to the attention of the Field Coordinator.

e. d. Uncap the well and monitor the air space immediately above the open casing per the health and safety plan. Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the Water Sampling Data Form (SOP 5.1).

f. Obtain a depth to water level measurement according to the procedures outlined in SOP 5.1. Calculate the volume of water in the well (cased well volume) as follows:

$$\pi \times \left(\frac{d}{2}\right)^2 \times (h_1 - h_2) \times 7.48 = \text{cased well volume (in gallons)}$$

where:

d = inside diameter of well casing (in feet)

h_1 = depth of well from top of casing (in feet)

h_2 = depth to water from top of casing (in feet)

Record static water level measurement and calculations on the Water Sampling Data Form (SOP 5.1). Measure and record the depth of the pump intake. Leave the water level indicator probe in the monitoring well during purging and sample collection.

If using non-dedicated equipment lower the pump and associated tubing and/or lines into the well.

e. Attach the compressor or cylinder to the controller and the controller to the gas supply line, making sure that the compressor is downwind of the monitoring well. Connect the discharge line from the pump to a flow-through cell. A "T" connection is needed prior to the flow cell to allow for the collection of water for the turbidity measurements. The discharge line from the flow-through cell

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must be directed to a container to contain the purge water during the purging and sampling of the monitoring well.

f. Start pumping the well at a low flow rate (0.2 to 0.5 liter per minute) and slowly increase the speed. Check water level. Maintain a steady flow rate while maintaining a drawdown of less than 0.33 feet. If drawdown is greater than 0.33 feet lower the flow rate. 0.33 feet is a goal to help guide with the flow rate adjustment. It should be noted that this goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience.

g. Measure the discharge rate of the pump. Also, measure the water level and record both flow rate and water level on the groundwater sampling log. Continue purging, monitor and record water level and pump rate every three to five minutes during purging. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well.

g. During the purging, a minimum of one tubing volume (including the volume of water in the pump and flow cell) must be purged prior to recording the water-quality indicator parameters. Then monitor and record the water-quality indicator parameters every three to five minutes. The water-quality indicator field parameters are turbidity, dissolved oxygen, specific electrical conductance, pH, redoxpotential and temperature. Oxidation-reduction potential may not always be an appropriate stabilization parameter, and will depend on site-specific conditions. However, readings should be recorded because of its value as a double check for oxidizing conditions. The stabilization criterion is based on three successive readings of the water quality field parameters: pH ± 0.1 pH units; Specific electrical conductance (SEC) ± 3% S/cm; Oxidation-reduction potential (ORP) ± 10 millivolts; Turbidity ± 10 % NTUs (when turbidity is greater than 10 NTUs); Dissolved oxygen ± 0.3 milligrams per liter. Once the criteria have been successfully met indicating that the water quality indicator parameters have stabilized, then sample collection can take place.Attach the sampling tube to the discharge supply line. Adjust the pressure/discharge cycle on the controller.

h. If a stabilized drawdown in the well can't be maintained at 0.33 feet and the water level is approaching the top of the screened interval, reduce the flow rate or turn the pump off (for 15 minutes) and allow for recovery. It should be noted whether or not the pump has a check valve. A check valve is required if the pump is shut off. Under no circumstances should the well be pumped dry. Begin pumping at a lower flow rate, if the water draws-down to the top of the screened interval again turn pump off and allow for recovery. If two tubing volumes (including the volume of water in the pump and flow cell) have been removed during purging then sampling can proceed next time the pump is turned on. This information should be noted in the field notebook or ground-water sampling log with a recommendation for a different purging and sampling procedure.Begin purging. Collect, transport, and dispose of purge water in accordance with the criteria specified by the project work plans.

i. Physical parameters (pH, specific conductance, and temperature) of the purge water will be measured when purging begins and then periodically throughout the purging procedure. These measurements will be recorded on the Water Sampling Data Form (SOP 5.1). Purging is considered complete when a minimum of three casing volumes have been removed and pH, specific conductivity, and temperature measurements have stabilized (i.e., three consecutive pH, specific conductance, and temperature readings are within tolerances specified in the project work plans). If stability is not reached within the removal of three well volumes, then purging is continued until a maximum of five cased well volumes have been removed.

For slowly recharging wells, the parameters may not stabilize. In this case, purging will be considered complete upon removal of a minimum three well volumes.

j. Allow the well to recover to at least 80 percent of the initial cased well volume prior to sampling.

k.h. Inspect the sampling bottles (obtained from the analytical laboratory prior to the sampling event) to be used to ensure that they are appropriate for the samples being collected, are undamaged, and have had the appropriate types and volumes of preservatives added. The types of sample containers to be used and sample preservation requirements will be provided in the project work plans and will comply with SOP 20.1.

l. Turn on the pump and adjust the pressure/discharge cycle on the pump controller so that the water will flow smoothly and without agitation into the sample containers.

m. Collect the sample directly into the provided sample bottle (container), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the sample. Completely fill the bottle; however, samples collected for metals and general water chemistry analysis should be filled to the base of the bottle neck.

n. The samples should be collected in the order of volatility, collecting the most volatile samples first, followed by the least volatile samples. The volatile samples should be collected during one full discharge cycle. Do not partially fill a volatile sample during one cycle and complete the filling during the next cycle.

i. Maintain the same pumping rate or reduce slightly for sampling (0.2 to 0.5 liter per minute) in order to minimize disturbance of the water column. Samples should be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. Disconnect the pump's tubing from the flow-through-cell so that the samples are collected from the pump's discharge tubing. For samples collected for dissolved gases or Volatile Organic Compounds (VOCs) analyses, the pump's tubing needs to be completely full of ground water to prevent the ground water from being aerated as the ground water flows through the tubing. The sequence of the samples is immaterial unless filtered (dissolved) samples are collected and they must be collected last. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container. When filling the VOC samples a meniscus must be formed over the mouth of the vial to eliminate the formation of air bubbles and head space prior to capping. In the event that the ground water is turbid,(greater then 10 NTUs), a filtered metal (dissolved) sample also should be collected.

o. j. If filtered metal sample is to be collected, the Samples that require filtering should be collected last. The samples should preferably be filtered using a disposable vacuum filterization filtration unit. The required filter mesh should be stipulated in the project work plans.

p. k. Cap the bottle. Custody seals may be used for additional sample security. Fill out and attach the sample label to the bottle per SOP 17.1. The sample will be assigned a sample number per SOP 17.2.

l. Disconnect the tubing that extends from the plate at the wellhead (or cap) and discard after use.

m. Close and lock the well.

q. n. Document the sampling event on the Field Activity Daily Log (FADL) (SOP 1.1).

As soon as possible after sample collection, place the sample container(s) in a separate, appropriately sized, airtight, seam sealing, polyethylene bag (i.e., ziplock). Seal the bag, removing any excess air. Place the bagged sample inside the shipping container.

o. Handle and ship the sample according to the procedures outlined in SOP 2.1, following appropriate custody procedures described in SOP 1.1. Samples stored temporarily on site will be maintained per SOP 19.1.

r. p. Collect, transport, and dispose of purge water in accordance with the criteria specified by the project work plans.

4.2.3 Ground Water Purging and Sampling with a Peristaltic Pump

a. Pre-sample purging and sampling will be conducted in accordance with the project work plans. The standard procedure for ground water purging and sampling using a peristaltic pump is described below.

b. Inspect the equipment to ensure that it is in good working order.

c. Conduct all field analytical test equipment (pH, temperature, conductivity) calibration.

d. Conduct equipment decontamination. However, the old Tygon™ tubing should not be decontaminated. New tubing should be used for each well.

e. Conduct wellhead inspection and air space monitoring.

f. Obtain a water level measurement and calculate the cased well volume.

g. Connect new Tygon™ tubing to the rotor head of the pump motor and tighten until snug.

h. Run a short section of the tubing from the discharge side of the pump head to a collection vessel.

i. Insert the free end of the influent tubing into the well and lower it to the middle of the well screen.

j. Begin and conduct purging.

k. Purging will be considered complete. Once purging is completed, allow the well to recover to at least 80 percent of the initial cased well volume prior to sampling.

l. Inspect the sampling bottles to be used.

m. Turn on and adjust the rotor speed of the pump so that the water will flow smoothly and without agitation into the sample bottles.

n. Collect the sample directly into the provided sample bottle (container), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the sample. Completely fill the bottle; however, samples collected for metals and general water chemistry analyses should be filled to the base of the bottle neck.

o. The samples should be collected in the order of volatility.

p. Samples that require filtering should be collected last. The samples should preferably be filtered using a disposable vacuum filterization unit. The required filter mesh should be stipulated in the project work plans.

q. Appropriately cap, label, and number the samples.

r. Document the sampling event on the FADL (SOP 1.1).

s. Appropriately seal, store, handle, and ship the samples.

4.2.4 Ground Water Purging and Sampling with an Electric Submersible Pump

a. Pre-sample purging and sampling will be conducted in accordance with the project work plans. The standard procedure for ground water purging and sampling using a submersible pump is described below.

b. Inspect the equipment to ensure that it is in good working order.

c. Conduct field analytical test equipment (pH, temperature, conductivity) calibration.

d. Conduct equipment decontamination.

e. Conduct wellhead inspection and air space monitoring.

f. Obtain a water level measurement and calculate the cased well volume.

g. If using non-dedicated equipment, lower the pump and associated lines into the well.

h. Place the generator downwind of the well. Start the generator, and then plug the pump into the generator.

i. Begin and conduct purging.

j. Purging will be considered complete. Once purging is completed, allow the well to recover to at least 80% of the initial cased well volume prior to sampling.

k. Inspect the sampling bottles to be used.

l. Turn on and adjust the flow rate of the pump by using the check valve on the discharge line so that the water will flow smoothly and without agitation into the sample bottles.

m. Collect the sample directly into the provided sample bottle (container), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the sample. Completely fill the bottle; however, samples collected for metals and general water chemistry analyses should be filled to the base of the bottle neck.

n. The samples should be collected in the order of volatility. An electric submersible pump is not recommended for collecting volatile organic samples.

o. Samples that require filtering should be collected last. The samples should preferably be filtered using a disposable vacuum filterization unit. The required filter mesh should be stipulated in the project work plans.

p. Appropriately cap, label, and number the samples.

q. Document the sampling event on the FADL (SOP 1.1).

r. Appropriately seal, store, handle and ship the samples.

4.2.5 Ground Water Purging and Sampling with a Bailer

a. Pre-sample purging and sampling will be conducted in accordance with the project work plans. The standard procedure for ground water purging and sampling with a bailer is described below.

b. Inspect the equipment to ensure that it is in good working order.

c. Conduct field analytical test equipment (pH, temperature, conductivity) calibration.

d. Conduct equipment decontamination.

e. Conduct wellhead inspection and air space monitoring.

f. Obtain a water level measurement and calculate the cased well volume.

g. Secure the bailer to bailing line or chain.

h. Begin purging by slowly lowering the bailer into the ground water. Allow the floating ball valve to seat, and slowly retrieve the bailer. Repeat this procedure to purge the well. Collect, transport, and dispose of purge water in accordance with the criteria specified in the project work plans.

i. During purging, the descent of the bailer should be controlled to prevent freefall inside the well. In the event the bailer encounters an obstruction inside the well, no attempts may be made to push the bailer beyond the obstruction. If the bailer becomes lodged in the well, the line should not be pulled with such force that it

~~would part from the bailer. Such conditions should also be noted in the FADL (SOP 1.1) and brought to the immediate attention of the Field Coordinator.~~

~~j. Purging will be considered complete. Once purging is completed, allow the well to recover to at least 80% of the initial cased well volume prior to sampling.~~

~~k. Inspect the sampling bottles to be used.~~

~~l. Lower the sample collection bailer and submerge into the water column as above. Retrieve the bailer and insert a bottom emptying device into the bailer so that the water will flow smoothly and without agitation into the sample bottles.~~

~~m. Collect the sample water directly into the provided sample bottles (containers), allowing the discharge to flow gently down the inside of the bottles, minimizing aeration of the sample. Completely fill the bottles; however, samples collected for metals and general water chemistry analyses should be filled to the base of the bottle neck.~~

~~n. The samples should be collected in the order of volatility.~~

~~o. Samples that require filtering should be collected last. The samples should preferably be filtered using a disposable vacuum filterization unit. The required filter mesh should be stipulated in the project work plans.~~

~~p. Appropriately cap, label, and number the samples.~~

~~q. Document the sampling event on the FADL (SOP 1.1).~~

~~r. Appropriately seal, store, handle, and ship the samples.~~

5.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

SOIL ORGANIC VAPOR SAMPLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for collecting soil organic vapor (SOV) samples and documenting the collection process. The details within this SOP should also be used in conjunction with project work plans.

2.0 REFERENCES

2.1 *Schuring, D.G., 1989, Soil Gas Testing: A Possible Alternative to Conventional Monitoring Methods, Hazmat World - Feature Report: Water Issues*

2.2 *Nadeau, R.J., T.S. Stone, and G.S. Klinger, March 1985, Sampling Soil Vapors to Detect Subsurface Contamination: A Technique and Case Study*

2.3 *Marrin, D.L., and H.B. Kerfoot, 1988, Soil Gas Surveying Techniques, Environmental Science and Technology, Vol. 22, No. 7, pp. 740-745*

2.4 *SOP 2.1 - Sample Handling, Packaging and Shipping*

2.5 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.6 *SOP 13.1 - Indoor Air Quality Sampling Using SUMMA® Canisters*

2.7 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

None.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that SOV samples are properly collected and the sampling event is properly documented in accordance with this and any other appropriate procedure. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with SOV sampling. If perceived variances occur, the PQAS is also responsible for issuing notices of nonconformances and requests for corrective action.

4.1.3 Field personal assigned to SOV sampling activities are responsible for completing their tasks according to the specifications outlined in the HSOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Field Coordinator or the PQAS.

4.2 Sample Collection

A number of devices are available for the collection of SOV samples. The analytical requirements, the sample depth, the material through which the sample probes are to be driven, and whether the sampling points are to be temporarily or permanently installed must be taken into account when determining the proper SOV sampling equipment to use. The project work plans will identify, as applicable:

- SOV sampling objectives;
- Depths and locations of sampling points;
- Sampling equipment to be used;
- Numbers and volumes of samples to be collected;
- Types of chemical analyses to be conducted for the samples;
- Specific quality control (QC) sampling and procedures required;
- Drilling or installation requirements (for permanent points), as required; and,
- Specific procedures to be performed in addition to those covered in this SOP.

The project work plans and this SOP should therefore be reviewed and understood before conducting SOV sampling at the site.

The standard procedure for field personnel to use in the collection of SOV samples is described below.

4.2.1 Prior to drilling or driving SOV sampling points, ensure that the sample locations have been appropriately cleared for all underground utilities per the project work plans. Review all forms and diagrams documenting the location of the cleared SOV points, as well as that of any underground utility lines or other obstructions.

4.2.2 Inspect all SOV sampling equipment to ensure that it is in good working order.

4.2.3 Refer to the project work plans to determine the appropriate instrument(s) needed to screen the borehole for volatile organic compounds (VOCs). Calibrate all field analytical and health and safety monitoring equipment according to the instrument manufacturer's specifications. Calibration results will be documented on the appropriate form(s), as specified by the project work plans. Instruments that can not be calibrated according to the manufacturer's specifications will be removed from service and tagged.

4.2.4 Don the appropriate personal protective equipment as specified in the project work plans and health and safety plan.

4.2.5 The sampling points should be surveyed or mapped and clearly marked prior to sampling. The sample should be collected at the marked location. If the collection point must be moved, significantly, the new location must be approved by the Site Superintendent.

4.2.6 Clear the area to be sampled of surface debris and vegetation using appropriate equipment as specified in the project work plans. Sampling equipment should not be used for this purpose.

4.2.7 Prior to sampling and between sampling locations, decontaminate the sampling equipment according to the procedures outlined in SOP 6.1. Record the decontamination activities on the Field Activity Daily Log (FADL) (SOP 1.1), and/or the appropriate form(s) as specified by the project work plans.

Note: Some projects may require the collection of QC samples after decontamination of the sampling equipment. This sampling must be conducted as required by the project work plans.

4.2.8 Drive the sample probe to the appropriate depth (hydraulically, electrically, or manually), as specified in the project work plan.

4.2.9 If probe refusal is encountered, document the time and depth of refusal on the FADL and report the refusal to the Site Superintendent; refer to the project work plans to determine the proper course of action.

4.2.10 Once the probe has been driven to the target depth, connect the sampling port on the probe to a low volume pump with a piece of dedicated Teflon™ tubing. Using the low volume pump, purge a measured volume of air from the probe (as specified in the project work plans).

4.2.11 Collect the sample by drawing a measured aliquot of air through the probe and into the designated sample container (as specified in the project work plans). Typical sample containers include Tedlar™ and Mylar® bags, glass bulbs, syringes, adsorption tubes, and SUMMA® canisters. (Refer to SOP 13.1 for guidelines on use of SUMMA® canisters.) Sample containers may be reused if they are decontaminated and analyzed for contaminants prior to use per the project work plans.

4.2.12 Seal the sample container and handle the sample according to the procedures outlined in SOP 2.1.

4.2.13 Label the sample appropriately (date and time sample was collected, sample location, sample team members and signatures, etc.). For SUMMA® canisters, do not apply adhesive label to canister; use the tag provided. Document the sampling event on the FADL (SOP 1.1).

4.2.14 Handle the sample according to the procedures outlined in SOP 2.1, Sample Handling, Packaging and Shipping. For samples submitted to a laboratory for analysis, Chain-of-Custody Record (SOP 1.1) shall be completed and maintained per the SOP and project work plans.

4.2.15 Remove the sample probe (if temporary) and abandon the hole in the manner specified in the project work plans. For permanent sampling installations, cap and secure the sample point as required in the project work plans.

5.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

CONE PENETRATION TESTING AND HYDROPUNCH® GROUND WATER SAMPLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for conducting cone penetration testing (CPT), soil sampling using a CPT rig, and HydroPunch® ground water sampling. The details within this SOP should also be used in conjunction with project work plans.

2.0 REFERENCES

2.1 *ASTM, 1988, Standard Method for Deep, Quasi-Static, Cone and Friction-Cone Penetration Tests of Soil, Designation: D 3441-86, Volume 4.08 Soil and Rock, Building Stones: Geotextiles, pp. 409-414*

2.2 *Manchon, B., 1992, Introduction to Cone Penetrometer Testing and Ground Water Samplers, Sixth National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods, May 1992*

2.3 *SOP 1.1 - Chain of Custody*

2.4 *SOP 2.1 - Sample Handling, Packaging and Shipping*

2.5 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.6 *SOP 6.2 - Drilling and Heavy Equipment Decontamination*

2.7 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Cone

The cone-shaped point of the penetrometer tip, upon which the end-bearing resistance develops.

3.2 Cone Penetrometer

An instrument in the form of a cylindrical rod with a conical point, designed for penetrating soil and soft rock and for measuring the end-bearing component of penetration resistance.

3.3 Cone Resistance or End-Bearing Resistance

The resistance to penetration developed by the cone, equal to the vertical force applied to the cone divided by its horizontally projected area.

3.4 HydroPunch®

A device used to collect ground water samples using CPT or drill rig technology. Various forms of the HydroPunch® exist; they vary in the method used for sample collection. HydroPunch I® uses the body of the hydropunch to collect and retrieve the sample. HydroPunch II® allows for the collection of water samples using a bailer lowered within the CPT rods or drill stem.

3.5 Sounding

The entire series of penetration tests performed at one location.

3.6 Friction Ratio

The ratio of friction resistance to cone resistance, expressed in percent.

3.7 Friction Resistance

The resistance to penetration developed by the friction sleeve, equal to the vertical force applied to the sleeve divided by its surface area. This resistance consists of the sum of friction and adhesion.

3.8 Differential Pore Pressure Ratio

A calculated parameter equal to the excess pore pressure measured behind the tip divided by the sum of the tip resistance (corrected for pore pressure effects and the total overburden stress). Used in combination with the end-bearing resistance to infer lithology.

3.9 Pore Pressure

Water pressure in the formation.

3.10 Push Rods

The thick-walled tubes, or other suitable rods, used for advancing the penetrometer tip or HydroPunch® to the required test depth.

4.0 PROCEDURE

Depending on the sampling activities to be performed, CPT/HydroPunch® testing may require multiple runs to complete the desired tests. The first run is generally conducted to generate stratigraphic or hydrogeologic information. The stratigraphic or hydrogeologic data is then evaluated to determine optimum depth intervals to obtain soil and ground water samples, which will be collected in subsequent runs.

CPT soundings, and soil and ground water sampling will be performed by an experienced contractor under the direction of the prime contractor or their subcontractors. All CPT, soil sampling, and HydroPunch® techniques covered in this SOP will be performed in accordance with the project work plans. The project work plans will identify the following:

- Testing and sampling objectives;
- Locations and depths of CPT and sampling points;
- Numbers and volumes of soil or ground water samples to be collected;
- Types of chemical analyses to be conducted for the samples;
- Specific quality control (QC) procedures and sampling required; and,
- Specific procedures to be performed in addition to those covered in this SOP.

At a minimum, the procedures outlined below for CPT, soil sampling, and HydroPunch® ground water sampling will be followed.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all CPT, soil sampling, and HydroPunch® activities are conducted and documented in accordance with this and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field activities and documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, generation of variances to CPT and sampling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to CPT, soil sampling, and HydroPunch® activities are responsible for completing their tasks according to this and other appropriate procedures. All staff are responsible for reporting deviations from the procedure to the Field Coordinator or the PQAS.

4.2 Preparation Procedures

4.2.1 Prior to commencement of CPT activities, ensure that all CPT, soil sampling, and HydroPunch® locations have been appropriately cleared of all underground utilities and buried objects per the project work plans. Review all forms and diagrams documenting the location of the cleared sampling and CPT locations, as well as that of any underground utility lines or other buried objects.

4.2.2 Perform a specific calibration of air monitoring equipment required for air space monitoring according to the instrument manufacturer's specifications. Calibration results will be recorded on the appropriate form(s), as specified in the project work plans. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

4.2.3 Don the appropriate personal protective equipment specified in the project work plans and health and safety plan.

4.3 Cone Penetration Testing

In general, the CPT is the first run to be conducted. The CPT rig is normally truck-mounted and contains a hydraulic push system (20 ton is typical). The depth of investigation will typically be less than 100 feet below ground surface (bgs). Lighter weight rigs can be utilized for shallow surveys up to approximately 15 feet bgs.

Some CPT rigs are equipped with an automatic decontamination system featuring an enclosed chamber that may be mounted beneath the CPT rig (project-specific decontamination requirements are specified in the project work plans). This chamber contains scrubbers and spray nozzles for pressure washing of the CPT probe as it is retrieved from the ground. In this type of system, all activities are conducted within the enclosed CPT rig.

The standard procedure for conducting stratigraphic and hydrogeologic investigations is described below.

4.3.1 Obtain specifications on the type and dimensions of the probes and equipment, along with the results of current shop calibrations from the CPT subcontractor.

4.3.2 With the CPT subcontractor, inspect all equipment to ensure that it is in proper working order.

4.3.3 Examine data from adjacent soil borings, if available. Initial correlation of the CPT data with site lithologies will be accomplished by comparison with existing boring logs, geophysical logs, and CPT logs.

4.3.4 Before moving onto the site, decontaminate the outside of the rig per SOP 6.2 and the project work plans. For those rigs that do not have an automatic decontamination system, the CPT probe and rods should also be decontaminated per SOP 6.2.

4.3.5 Calibrate the CPT cones at zero load reading in air and water, shielding the cone from direct sunlight before commencement of testing at each location.

4.3.6 Commence the test and advance the CPT probe into the subsurface at a consistent, controlled rate of 0.03 to 0.07 feet per second (1 to 2 centimeter per second), unless conditions prevent that rate.

4.3.7 Record real-time field plots consisting of depth, cone tip resistance, sleeve friction resistance, and friction ratio. Pore pressure and differential pore pressure ratio may be included in some cases.

4.3.8 Pore pressure dissipation tests may be conducted to determine relative flow rates at specific depths. The CPT probe is held stationary at a given depth and data are recorded for a set time interval. The time interval is dependent on the lithology of the zone being tested.

4.3.9 Once the CPT is pushed to the maximum desired depth, data collection is terminated. The CPT is retracted from the hole and the tip and rods are wiped down during extraction.

4.3.10 Upon completion of a test, calibrate the piezocone again to zero load reading and compare this to the initial reading.

4.3.11 Abandon the hole in accordance with the project work plans.

4.3.12 All pertinent information observed during the investigations will be recorded by the rig geologist or engineer. Information will be recorded on the Field Activity Daily Log (FADL) (SOP 1.1) and/or appropriate form(s) as specified in the project work plans. Any and all problems or unusual conditions encountered should also be noted on the above forms and brought to the attention of the Site Superintendent.

4.4 Soil Samples

If required, soil sampling will follow the CPT analysis run. Soil sampling locations will be placed up-dip relative to the location of the previous CPT testing run. The standard procedure is described below.

4.4.1 Assemble and check the necessary sampling equipment before soil sampling. Decontaminate all downhole sampling equipment before sampling, as described in SOP 6.1. The rig should also be decontaminated per SOP 6.2.

4.4.2 Deploy and advance the soil sampling probes with the CPT rods to collect soil samples at the sample intervals specified in the project work plans. The sample intervals may be identified from the adjacent CPT data and any other subsurface data available. The sampling device contains removable liners that fit inside the drive tip mechanism.

4.4.3 Retrieve the sampler and remove the liners containing the soil. Cover the ends of each liner to be submitted for chemical analysis with Teflon film and then cap with plastic end caps.

4.4.4 Each liner to be submitted for analysis will be appropriately labeled. The label will be filled out using waterproof ink and will contain, at a minimum, the following information:

- Project number;
- Sample point (or boring) number;
- Bottom depth of liner;
- Date and time of sample collection;
- Parameters for analysis; and,
- Sampler's initials.

4.4.5 As soon as possible after sample collection, place the sample in an appropriately sized, airtight, seam-sealing polyethylene bag (e.g., ziplock). Seal the bag, removing any excess air.

4.4.6 Document the sampling event on the FADL (SOP 1.1) or an equivalent form as specified in the project work plans.

4.4.7 Handle the sample according to the procedures outlined in SOP 2.1. For samples submitted to a laboratory for analysis, a Chain-of-Custody Record (SOP 1.1) shall be completed and maintained per SOP 1.1 and the project work plans.

4.4.8 Abandon the hole following the procedure outlined in the project work plans.

4.5 HydroPunch® Ground Water Samples

The HydroPunch® sample locations, if conducted in conjunction with CPT data collection, will be located a few feet in the estimated upgradient direction from the previous CPT location. HydroPunch® sampling will be conducted in accordance with the project work plans. The standard procedure for HydroPunch® sampling is described below.

4.5.1 Decontaminate the HydroPunch® probe and push/drive rods in accordance with SOP 6.1. If the HydroPunch® model is being used with a small diameter bailer, the bailer and associated equipment must also be decontaminated in accordance with SOP 6.1.

4.5.2 Advance the probe to the target depth, which will commonly be a permeable layer as defined from the adjacent CPT or other stratigraphic information. Depth control is maintained by counting the number of whole and partial push or drive rods used. The HydroPunch® is measured at the tip of the tool and zeroed at the ground surface.

4.5.3 To obtain a ground water sample, retract the outer jacket of the HydroPunch® probe to allow ground water inflow into the sample chamber. An optional technique, used to determine when the sample chamber is full, is as follows:

- Place a surgical glove over the end of the push rod before the outer jacket of the sampler is retracted.
- As water enters the sample chamber and displaces air, the glove will inflate.
- Once the glove stops inflating, water has ceased flowing into the chamber and the sample may be retrieved.

The length of time required for the sample chamber to fill is a function of the relative permeability of the formation and the presence or absence of materials which may clog the filter screen, thereby inhibiting the flow of water.

4.5.4 Retract the probe from the hole, disconnect the push rods from the HydroPunch®, and remove the upper valve. Replace the upper valve with a Teflon™ stop cock valve and a disposable tube (HydroPunch® I). Turn the sampler upside down, open the cock valve and decant the sample into the sample container.

4.5.5 If using the HydroPunch®II model with a small diameter bailer, the water sample is retrieved by lowering the bailer through the inside of the push rod into the sample chamber. The water recovered in the bailer is then decanted directly into the appropriate sample containers.

4.5.6 If collecting samples for analysis of volatile organic compounds (VOCs), first completely fill the VOC sample vials. Each filled, capped vial will be inverted to ensure no air bubbles are present. If an air bubble is present, the vial will be opened and refilled with an additional sample. The vial will be immediately capped and checked again for bubbles. If air bubbles are still present, the VOC sample vial will be discarded and a new vial used. The VOC sample vial filling procedure is then repeated until no air bubbles are present.

4.5.7 If other sample analyses are required, fill the other sample containers after the VOC sample vials are filled. Samples collected for metals and general minerals analysis will be filled to the base of the bottle neck. Care will be taken not to aerate the sample during transfer from the bailer to the sample bottles and not to overfill bottles containing preservatives. All samples shall be appropriately preserved per the project work plans. Each sample container to be submitted for analysis will be appropriately labeled. The label will be filled out using waterproof ink and will contain, at a minimum, the following information:

- date and time sample was collected;
- sample location;
- the initials of the individual conducting the sampling; and,
- any additional required information.

4.5.8 Document the sampling event on the FADL (SOP 1.1) or an equivalent form as specified in the project work plans.

4.5.9 Place the labeled vials in seam-sealing plastic bags (i.e., ziplock). Seal the bag, removing any excess air.

4.5.10 Conduct a visual inspection of the turbidity of samples and record on the FADL (SOP 1.1) to provide a qualitative record of results.

4.5.11 Handle the samples according to procedures outlined in SOP 2.1. For samples submitted to a laboratory for analysis, a Chain-of-Custody Record (SOP 1.1) shall be completed and maintained per SOP 1.1 and the project work plans.

4.5.12 After samples are collected, water levels may be measured. For water level measurements using the HydroPunch®, allow enough time for ground water to fill the sample chamber and the push rods. After static water level conditions are achieved, an electric tape is lowered through the push rods and the water level is measured. Document results on the appropriate form, as specified by the project-specific work plans.

4.5.13 Abandon the hole following the procedure outlined in the project work plans.

4.6 Reporting

The CPT contractor should provide a field survey report of the test data before demobilizing from each location. The CPT contractor should record on the survey report the operator's name, date of the survey, and the CPT location number. The report should include the following:

- descriptions of the various probes and equipment, and the results of calibrations performed;
- profiles of cone tip resistance, sleeve friction resistance, friction ratio, inclination, pore pressures, and differential pore pressure ratio versus depth; and,
- a list of the derived geotechnical parameters related to the subsurface conditions, including soil types, standard penetration test blow counts, relative density, and shear strengths.

The report should then be reviewed, approved, and signed by the rig geologist, rig engineer, or other responsible individual as identified in the project work plans. The report should be maintained per Section 5.0.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

SAMPLE COLLECTION, HANDLING AND DATA DOCUMENTATION FOR FIELD ANALYSIS USING GAMMA SPECTROMETER AND BETA SCINTILLATION DETECTOR

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure has been developed for sample preparation, handling, transport, and data documentation when using a field gamma spectrometer and/or beta scintillation detector.

2.0 REFERENCES

2.1 *SOP 2.1 – Sample Handling, Packaging and Shipping*

2.2 *SOP 17.1 – Sample Labeling*

2.3 *SQP 4.2 – Records Management*

3.0 PROCEDURE

3.1 Responsibilities

The Project Task Leader is responsible for ensuring that samples for field analysis using the High Priority Germanium Detector (HPGe) and Beta Scint Detector (BSD) are properly collected and the sampling event is properly documented in accordance with this procedure. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this sampling. If perceived variances occur, the PQAS is also responsible for issuing notices of nonconformances and requests for corrective action.

Field personal assigned to these sampling activities are responsible for completing their tasks according to the specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Field Coordinator or the PQAS.

The Laboratory Technician is responsible for analyzing the samples in accordance with the established procedures.

3.2 Sample Preparation and Handling

Table 1 describes the sample specifications, including required weight, volume, quality and container types, needed for each Gamma Spectrometry (GS) using a High Purity Germanium Detector (HPGe) and Beta Scint Detector (BSD) analysis.

Table 1. Sample Specifications for HPGe and BSD Analysis

Parameter	Gamma Spectromety Using HPGe Detector (Radium-226/Cesium-137)	Beta Scint Detector (Strontium-90)
Sample Container	Marinelli Beaker	1 gallon Ziploc Bag
Sample Volume/weight	1 liter beaker/6 pounds	1 gallon bag/6 pounds
Other Requirements	No voids in container	No objects > ¼" mesh or organic matter

3.3 Gamma Spectrometer Sample Preparation

Procedures that will be followed during sample preparation for the gamma spectrometer analysis are presented below.

- Place soil directly in the Marinelli beaker with minimal disturbance to soil;
- Ensure that no voids are present in the beaker;
- Seal the top of the beaker using electrical tape;
- Place sample label on the top cover of the beaker;
- Sample labels shall be in accordance with SOP 17.1 and shall include the Weiss Associates (WA) sample ID, sampling time and date, requested analyses, and the sampler's initials;
- If appropriate, ensure that the sample container is frisked by the Radiological Control Technician (RCT) in accordance with SOP 2.1 if samples are collected from within a Controlled Area (CA); and,
- If appropriate, deliver the sample to the "courier" outside of the CA within five minutes of collection or hand carry sample within 5 minutes of sample collection to gamma spectrometer operator.

3.4 Beta Scintillation Detector Sample Preparation

Procedures that will be followed during sample preparation for the BSD are presented below.

- Place soil to be analyzed in the sifting device with a minimum of ¼" Mesh screen;
- Sift the sample and remove any other visible debris and organic matter;
- Collect the sifted soil sample and place it in a 1 gallon ziploc bag;
- Seal and label the bag;
- Sample labels shall include the WA sample ID, sampling time and date, requested analyses, and the sampler's initials;
- If appropriate, ensure that the sample container is frisked by the rad tech if the sample was collected from within a controlled area; and
- If appropriate, deliver the sample to the "courier" outside of the CA or hand carry the sample to the BSD operator.

3.5 Sample Transport

Once the samples have been cleared out of the CA, either the field sampler or a designated courier will transport the samples to the Animal Hospital No. 1 (AH-1) where the field analytical instruments have been setup. Sample transport from a CA shall follow the procedures described below.

- Place soil samples received from the CA inside a transport container;
- Transport container shall consist of a cooler or other rigid box;
- Each sample received from the CA shall be logged in the Sample Transport Log by the courier (sample of the log is attached);
- The sample ID, sample time, delivery time at the laboratory, and the transporter's initials shall be included on each Sample Transport Log;
- Upon arrival at the laboratory, samples shall be placed in the pre-designated "SAMPLE DROP-OFF" area; and,
- The Laboratory Technician shall be notified by radio 5-10 minutes prior to each sample drop-off.

3.6 Sample Documentation

Sample documentation will consist of recording the sample ID, sampler ID, field sample location, depth, soil type, time and date of sample collection, and resultant concentration as determined from the HPGe and/or BSD and are shown on the Gamma Spectrometry and Beta Scintillation Detector Sampling and Analysis Log (Attachment 5.1).

3.7 Sample Storage/Disposal

Once the samples have been analyzed, the Laboratory Technician will place the soil samples in their original container, seal each container, and place the container in a predetermined "ANALYSIS COMPLETE" area.

Depending on the analytical results of each sample, it will either be temporarily stored or disposed. Samples selected for storage will be placed in the "STORAGE AREA." The Construction Engineer will determine whether samples need to be stored.

At the completion of analytic testing, the sample will be returned to its point of origin by a field technician, sampler, and/or pre-designated courier. Each sample will be disposed of at its original location. The courier will note the fate of each sample on the Sample Transport Log.

3.8 Analytical Result Documentation

The Laboratory Technician will submit to the Weiss Associate (WA) Project Task Leader (PTL) or field geologist the analytical results at the completion of each day. The Laboratory Technician will tabulate analytical results in the Field Screening Analytical Results Form (attached).

4.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

5.0 ATTACHMENTS

5.1 Field Screening Sampling and Analysis Log

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

Attachment 5.1

Field Screening Sampling and Analysis Form

Field Screening Sampling and Analysis Form

Sample ID	Sample Location	Sample Depth	Soil Type	Time / Date	Sampler	Ra-226 Conc.	Cs-137 Conc.	Sr-90 Conc.

RADIUM-226 ANALYSIS BY GAMMA SPECTROMETER

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes the steps for operating the gamma spectrometer for radium-226 (Ra-226) analysis.

2.0 REFERENCES

2.1 *Final Quality Assurance Project Plan, Section 14, "Calibration and Maintenance of Measuring and Test Equipment"*

2.2 *Standard Quality Procedure No. 8.1, "Calibration and Maintenance of Measuring and Test Equipment"*

2.3 *Draft Pacific Northwest national Laboratory Technical Procedure, GEA-001, "Assay of Radium-226 in Soil Using High-Resolution Gamma-Ray Spectrometry," May 1998*

2.4 *Standard Operating Procedure No. 10.3, "Sample Collection, Handling and Data Documentation for Field Analysis Using Gamma Spectrometer and Beta Scintillation Detector"*

2.5 *Health and Safety Procedure No. 8.1, "Use of Liquid Nitrogen"*

3.0 ABBREVIATIONS

3.1 CA

Controlled Area

3.2 ID

Identification

3.3 HV

High Voltage

3.4 LEHR

Laboratory for Energy-Related Health Research

3.5 MCA

Multi-channel analyzer

3.6 Ra-226

Radium-226

3.7 RPD

Relative Percent Difference

4.0 OPERATING PROCEDURES

1. Prior to switching on the digital spectrometer, verify that the High Voltage Bias is set to 3,000 positive volts (each diode requires its own energy level; +/- Voltage).

2. Turn on the computer. Bring up MS-DOS from the Start menu. Use Alt-Tab to toggle back between windows and DOS.

3. Open Maestro 32 located in the Program Groups folder. Double-click on Maestro for Windows.

4. Verify that the toolbar reads "1 DSPEC-306" in the window on the right side of the screen.

5. Under the Acquire menu, select Pre-set Limits- Acquisition Presets. Set the Live Time to 600 seconds and leave the rest of the window blank.

6. Under the Acquire menu, select ADC Setup. Set the Lower Level Disc at 30, the Conversion Gain at 4096, and the Gating to Off.

7. The pre-set limits and ADC Setup only need to be entered the first time program is used.

8. Under the Acquire menu, select Adjust Controls. The Bias High Voltage (HV) must match the Bias HV on the metallic sticker on the diode. In the box labeled Bias HV, check the On box. This will gradually increase the voltage. Place the thorium check source in the lead cave and close the door. Make certain that the marker notch on the top of the lead cave aligns with the marker notch on the Marinelli beaker check source. In the shaping box, click Optimize; this sets pole zero. Then click the OK box.

9. Each morning the check source should be counted for 600 seconds. Under the Acquire menu, select Clear. Under the Services menu, select Job Control and the Run Job File window will appear. In the multi-channel analyzer (MCA) folder, select Calib and then click Open.

10. Thorium has 3 peaks around channels 238, 911 and 2,614.5. Examine the 238 and 911 peaks. If the peaks are not in their respective locations, adjust the amplifier gain using the following formula: $\frac{DesiredChannel}{ActualChannel}\ x\ EffectiveGain = AdjustedGain(\ EffectiveGain\ )$

11. After adjusting the Amplifier Gain, under the Services menu select Job Control, then select Run Job File. In the MCA folder, select Calib and then click Open.

12. When the Maestro program is finished counting the check source, a report will automatically print.

13. Once the results of the thorium source check are printed, check them against the sheets in the binder labeled 'Controls for Diode #39-TP40788A'. The net number of counts must fall within the high and low for channels 238 and 911. If the counts do not fall within that range, adjust the Amplifier Gain and rerun for 600 seconds. For a full description of the thorium checksource print-out procedure, refer to Section 4.0, Documentation.

14. After a satisfactory thorium source check has been run, the blank soil sample provided by Pacific Northwest National Laboratory should be loaded into the lead cave.

15. Under the Acquire menu, select Clear. Press the Go icon along the top of the screen and the program will begin counting the sample.

16. Under the File menu, select Save As. Save the spectrum in the Data folder on the "C" drive. Save the file as an integer CHN file in the following format: year, month, day, sample number (i.e., 00061901 for Sample 1 analyzed on June 19, 2000).

17. Press Alt-Tab to enter into MS-DOS. If the C:\DATA> prompt does not appear, type CD\DATA. At the C:\DATA> prompt, type SOIL 00061901(the file name you want to print) and press return.

18. A report will print with concentrations shown in microCuries per gram. The program assumes the sample weighs one gram. Therefore you must weigh the soil-filled Marinelli beaker on the digital scale and enter the information into the Excel workbook entitled '2000 Gamma Spec. Results.xls', the spreadsheet will automatically subtract the weight of an empty Marinelli beaker. Follow the instructions on the PROCEDURE sheet of that workbook.

19. Do one re-count for every ten samples (at least one per day).

20. The thorium source check should be run at the beginning and end of each day.

21. Upon completion of the day's tasks, go to the Acquire menu; select Adjust Controls and click the Bias HV switch from On to Off. Under the Start menu, select Shutdown and turn the power off on the CPU, the monitor, and Dspec.

22. The liquid nitrogen tank (dewar) on the gamma spectrometer should be filled about twice a week. The liquid nitrogen level should be checked every day with the long wooden dowel. When the level is at half-full, the dewar should be filled to capacity. Fill the gamma spectrometer tank from the large tank located just outside of the Controlled Area (CA) with the hose. Personal protective equipment, including insulated gloves and a face shield, should be worn when handling liquid nitrogen.

23. For each day of operation, follow the analysis sequence listed below:

    (1) Conduct a thorium source check.
    - <u>Criteria</u> (Peaks 238 and 911)
      Peak centroid: Within ±0.5 channel
      Net Counts: Channels 238 and 911 within high and low values (see "Gamma Daily Controls for Detector Ser. #39-TP40788A" binder)
    - If the number of net counts for Channels 238 and 911 are not within their high and low values, the Amplifier Gain will be adjusted accordingly (see steps 10- 13) and the thorium check source will be reanalyzed.

    (2) Analyze a "blank" (Laboratory for Energy-Related Health Research [LEHR] background) soil sample.

    (3) Analyze environmental samples.

    (4) Perform a duplicate analysis.
    - Perform after every 10 samples (at least once per day)
    - Re-count a sample that was already counted at the beginning of the day
    - Calculate the Relative Percent Difference (RPD = Difference ÷ Mean × 100%)

    (5) Conduct a thorium source check.
    - Perform at the end of the day, per step (1) above.

- If the number of net counts for Channels 238 and 911 are not within their high and low values, the gain will be adjusted and the samples will be reanalyzed the following day.

5.0 DOCUMENTATION

1. Thorium source check print-outs are three-hole punched and filed in the binder labeled "Gamma Daily Controls for Detector Ser. #39-TP40788A." From the print-outs, write the date, net counts, Full Width Half Maximum and the operator's initials for channels 238, 911 and 2,614.5 on the "Daily Gamma-Ray Spectrometer Control Check Source" form (see Attachment 5.1). On the top column of each sheet, also list the voltage, channel high, channel low and the count time in seconds. This binder remains in the CA for daily reference.

2. All samples that are run in Maestro get recorded in the bound lab book labeled "Maintenance and Run Log". Within this book, record the sample identification (ID) number, the corresponding computer file name, the gross and tare weights and any information regarding the adjustment of the gain and/or zero. It should also include any observed abnormalities. This lab book remains in the CA for daily reference.

3. Analysis print-outs are stored in the file cabinet located next to the CA. From these print-outs, type the information including sample ID and weight, date/time collected, date/time counted, length of count, cesium-137 activity, lead-214 activity, bismuth-214 activity, Ra-226 activity (for each activity and include % error underneath it), and computer sample ID into the Excel workbook entitled '2000 Gamma Spec. Results.xls' located in C:\My Documents. In our on-site laboratory, the actual Ra-226 activity is quantified by taking the average of two of its daughter products, lead-214 and bismuth-214. The reported Ra-226 activity is inaccurate due to interference from the uranium-238 spectral peak. At the end of each day, print the workbook sheets that were completed that day. Three-hole punch the sheets and put them into a binder called LEHR Gamma Spectrometer Data Summary. This binder remains in the CA for daily reference.

4. All samples analyzed will be saved on the hard drive in C:\Data.

6.0 ATTACHMENTS

6.1 Daily Gamma-Ray Spectrometer Control and Check Source

6.2 Summary of LEHR Gamma-Ray Spectrometry Data

ATTACHMENT 6.1

DAILY GAMMA-RAY SPECTROMETER CONTROL AND CHECK SOURCE

DAILY GAMMA-RAY SPECTROMETER CONTROL CHECK SOURCE

TECHNICAL PROCEDURE REF.		
Diode ID		High
Diode S/N	CHANNEL NO.	Ave.
Std. ID		Low

DATE	VOLTS	CH. LOW	CH. HIGH	NET COUNTS	TIME (s)	F.W.H.M.	OPERATOR

ATTACHMENT 6.2

SUMMARY OF LEHR GAMMA-RAY SPECTROMETRY DATA

LEHR Data Summary — Date/Initial, Recorded by: — Summary of LEHR Gamma-Ray Spectrometry Data

Sample ID & Wt.	Date/Time Collected	Date/Time Counted	Length of Count (s)	Activity Cs-137 (pCi/g)	Activity Pb-214 (pCi/g)	Activity Bi-214 (pCi/g)	Average Activity Bi-214 & Pb-214 (pCi/g)	Activity Ra-226 (pCi/g)	Computer Sample ID (Yr-Mon-Day-##)
		Calibration level (μCi/g):		*1.7E-7*	*6.5E-7*	*6.5E-7*		*6.5E-7*	
		Calibration level (pCi/g):		*0.17*	*0.65*	*0.65*		*0.65*	

Ra-226 activity is the average of the Pb-214 & Bi-214 activities.
The shaded region for Ra-226 activity is not a reliable value and is for indication only.

Sample ID & Wt.	Date/Time Collected	Date/Time Counted	Length of Count (s)	Activity Cs-137 (pCi/g)	Activity Pb-214 (pCi/g)	Activity Bi-214 (pCi/g)	Average Activity Bi-214 & Pb-214 (pCi/g)	Activity Ra-226 (pCi/g)	Computer Sample ID (Yr-Mon-Day-##)
g				± %	± %	± %		%	
g				± %	± %	± %		%	
g				± %	± %	± %		%	
g				± %	± %	± %		%	
g				± %	± %	± %		%	
g				± %	± %	± %		%	
g				± %	± %	± %		%	

Notes:

Reanalyses Sample ID 0

Relative % Difference (RPD)= #DIV/0!

STRONTIUM-90 ANALYSIS BY BETA SCINTILLATION SENSOR

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This desktop procedure describes the steps for operating the beta scintillation sensor for strontium-90 (Sr-90) analysis.

2.0 REFERENCES

2.1 *Final Quality Assurance Project Plan, Section 14, "Calibration and Maintenance of Measuring and Test Equipment"*

2.2 *Standard Quality Procedure No. 8.1, "Calibration and Maintenance of Measuring and Test Equipment"*

2.3 *Standard Operating Procedure No. 10.3, "Sample Collection, Handling and Data Documentation for Field Analysis Using Gamma Spectrometer and Beta Scintillation Detector"*

3.0 ABBREVIATIONS

3.1 AC

Alternating current

3.2 DC

Direct current

3.3 ID

Identification

3.4 pCi/g

PicoCuries per gram

3.5 Sr-90

Strontium-90

4.0 OPERATING PROCEDURES

4.1 Sensor Startup

1) Remove all necessary components from the padded storage container:
   - BetaScint sensor
   - DC power supply (plus power cord)
   - Power supply-to-sensor cable
   - Compaq laptop computer running MS Windows
   - Power supply for laptop
   - Computer-to-sensor serial null-modem DB9 female/female cable

2) Connect the power cord to the back of the DC power supply and plug into an AC outlet (ensure that the unit is turned OFF prior to plugging into the AC power source).

3) Connect the power cable to the sensor and the DC power supply. A screw-type bayonet connector is attached to the sensor (connector orientation is restricted by positioning tabs) and the power leads are connected to RED and WHITE plugs on the DC power supply (BLACK plug is not used). Ensure that the positive (+) and negative (-) leads are not reversed (if this occurs inadvertently, the in-line fuse will blow when the DC power supply is turned on and must be replaced).

4) Connect the laptop computer to the sensor using a serial cable. The null-modem adapter connects to the back of the laptop. Verify that connections are secure.

5) Ensure that the VOLTAGE knob on the DC power supply is on the minimum setting (full counter-clockwise position) and that the CURRENT knob is at maximum setting (full clockwise position) before turning on the power. Turn the unit by pushing the switch on the front of the unit and increase the voltage slowly by turning the VOLTAGE knob clockwise until 18 volts are indicated on the right (voltage) meter. Current should automatically stabilize at 4 amps on the left (current) meter. Allow electronics to warm up and stabilize for 15 minutes.

6) Meanwhile, ensure that the laptop computer has an adequate battery supply or connect it to the AC power via the unit's AC-DC converter. Turn on computer. Following the warm-up period

(see #5 above), the system will be ready to initiate measurements. In the Windows Start menu, select Programs, then MS-DOS Prompt. The computer will switch to the DOS mode and display the prompt C:\WINDOWS>. Type *CD\Beta* and press the ENTER key. The computer will change directories and display the prompt C:\BETA>. The BetaScint sensor is now ready to initiate measurements.

4.2 Sensor Operation

1) Following warm up, initiate individual measurements by typing *go* and pressing the ENTER key at the C:\BETA> prompt. This command calls up a batch file (go.bat) that includes the user-specified measurement parameters* and an executable file (betacon.exe). It is assumed at this point that the sensor is calibrated for the soils being analyzed (if not, refer to the Sensor Calibration section below).

   *Note: The user-specified parameters may be changed by typing *edit go.bat* (Note the space between edit and go.bat) at the C:\BETA> prompt and pressing the ENTER key, which places the user into the computer's editing function. The user will then see and be able to modify the following command line:

   BETACON.EXE /t300 /s1.0 /i0.0 /b0.0 /dNo_Ident

   "BETACON.EXE" calls the aforementioned executable file -- this portion of the batch file should NOT be changed.

   The "/t300" segment is used to set the individual count times in units of SECONDS (in this example, the default count time is 300 seconds). The "/s1.0" and "/i0.0" segments are for indicating the slope and intercept values of the unique calibration for the measurements at hand (see Sensor Calibration section below). The "/b0.0" segment is for indicating the site-specific background count rate (in counts per second). The "/dNo_Ident" segment is for establishing a sample identifier and is not normally used.

   Changes are made to this batch file by moving the cursor (using ARROW keys) to the numerical portions of the file, deleting the old values, and typing in the new values while maintaining the existing file format. When the changes have been made, access the File menu. Save the new settings, then exit the file function. The user is then returned to the C:\BETA> prompt.

   Upon initiating a count, a new screen is displayed—this screen identifies the existing default parameter settings and a count-up timer that indicates the status of the current measurement. When the count is complete, this screen will automatically display the measurement results in units of picoCuries per gram (pCi/g).

2) Repeat this procedure to initiate subsequent counts.

4.3 Sensor Calibration

1) Prior to calibrating the sensor, the batch file (go.bat) must be modified as follows: change count time to 900 seconds (a minimum of 15 minutes per measurement is recommended for calibration counts which can also be accomplished by making three sequential measurements for 300 seconds each), set slope to 1.0, and set the intercept and background to 0.0. To modify this file, refer to the note in Section 4.2, Sensor Operation.

2) Set up the sensor at the location where analyses are to be performed. Initiate a location-specific background measurement by typing *go* and pressing the ENTER key at the C:\BETA> prompt. Record results (Note: results will be indicated in units of pCi/g, which is the default setting, although true units are "counts per second"). Repeat twice, for a total of three background measurements, and calculate the average of these values. Record the average value.

3) Place an "uncontaminated" soil sample (i.e., one that contains 0 pCi/g above background, of the contaminant in question) in a tray directly below the sensor, initiate a measurement, and record the results. Initiate measurements on a series of spiked soils (i.e., samples with known quantities of the contaminant in question) and record results. At least four spiked samples whose concentrations span the anticipated range of contamination levels, are recommended for a viable calibration. Using a linear least-squares method, calculate the slope and intercept values of the resulting linear calibration curve.

4) Modify the batch file (go.bat) by substituting the new values for slope, intercept, and background as described in the note under Section 4.2, Sensor Operation. The sensor is now calibrated and ready to measure samples with unknown contaminant concentrations.

4.4 Sensor Shutdown

1) When counting is complete, turn the VOLTAGE knob on the DC power supply down (full counter clockwise) and turn the unit off by pushing the button.

2) Disconnect all cables and place individual components in a padded storage container to preclude damage.

3) If desired, the computer can be returned to Windows mode by typing *exit* at the C:\BETA> prompt and pressing ENTER.

4.5 Sample Preparation and Handling

1) Samples of potentially contaminated soil should be treated as contaminated until proven otherwise. While handling the samples, the operator must wear protective gloves. Some installations also require a respiratory filter to prevent inhalation of sample dust. Do not handle contaminated samples if skin lesions, cuts or open sores could be exposed to the soil. Use a

plastic liner bag in the sample tray to completely collect and enclose the sample after measurements are complete. After completing the measurements, invert the plastic bag and seal the liner opening with tape.

2) An adequate sample for the BetaScint sensor requires sufficient soil to fill the sample tray with an even layer not less than one centimeter in thickness and not more than the depth of the tray. This may require between one and three kilograms of soil depending on the soil type and moisture content. Clumps of soil larger than one centimeter in diameter should be broken. Stones or other non-soil particles larger than one centimeter in diameter must also be removed. Remove any sharp particles that might puncture the sensor's plastic window covering if it comes in contact with the soil.

3) Excess moisture content in the sample can interfere with the accuracy of the measurements. The soil must be dry enough to break larger particles by hand. A moisture content testing device may be used to determine relative moisture content (On a scale of 1 to 4, 1 represents the dry end of the scale, and a measurement between 1 and 2 should be sufficiently dry for good results). If the moisture content is too high, spread the sample in the tray and allow to dry as long as necessary before taking readings.

4) Record the sample identification information (collection location and date, the name of the person collecting the sample, and a unique sample ID number), the date and time of testing, and the measurement results in pCi/g. Also record any unusual laboratory conditions or other facts related to the measurement.

4.6 Daily Operating Procedures

1) Turn on the sensor to warm it up:
   - Follow the operating procedures described in Section 3.1.

2) Check and record the lab conditions:
   - Temperature: Record at the same time daily. If large variances occur, record multiple readings.
   - Background Radiation: Set BETACON.EXE (/t300 /s1.0 /i0.0 /b0.0 /dNo_Indent). Record results in counts per second (cps). Results must fall between 4.0 and 5.0 cps.
   - Other Lab Conditions: Record any unusual circumstances.

3) Perform a quality assurance check:
   - Set BETACON.EXE: Default settings (/t300 /s1.51 /i-1.36 /b4.5 /dNo_Ident)
   - Record Sample 25-4 (the spike sample) as first Sample ID on the BetaScint Daily Results form. Record all data on this form.

4) Test samples as directed:
   - Ensure that the sample is properly sized, screened and dried before reading.
   - Record a full data set on each sample, and calculate the 1-sigma error.

5) Shut down the lab:
   - Turn off the power to the sensor and the laptop computer.
   - Wipe down the entire area (including the black bottom sensor) to remove dust.
   - Protect the equipment and any remaining samples.

4.7 Daily Analysis Sequence

For each day of operation, follow the analysis sequence listed below:

(1) Background Counting (empty tray)
- Criteria: between 4.0 and 5.0 cps. If the criteria is not met, corrective actions (such as cleaning the lab table) will be implemented.

(2) Sample 25-4 (Sr-90 at 23.9 pCi/g)
- Criteria: within ±10% (between 21.51 and 26.3 pCi/g) If the criteria is not met, corrective actions (such as homogenizing the sample) will be implemented.

(3) Environmental Samples

(4) Duplicate Analysis
- Perform after every 10 samples (at least one per day).
- Re-count a sample counted at the beginning of the day.
- Calculate the relative percent difference (RPD = Difference ÷ Mean × 100%).

(5) Sample 25-4 (Sr-90 at 23.9 pCi/g)
- Criteria: within ±10% (between 21.51 and 26.3 pCi/g) If the criteria is not met, corrective actions (such as homogenizing the sample) will be implemented and the samples will be reanalyzed the following day.

5.0 DOCUMENTATION

5.1 BetaScint

1) Each day, fill out a new BetaScint daily result worksheet in the workbook entitled "BetaScint log.xls" located in C:\My Document. The date, lab hours, and lab conditions (including temperature and beta background), as well as any comments on abnormalities, must be entered

into the worksheet. On this worksheet, write the sample ID, start time, count time (seconds), number of triples (the number used to quantify activity), activity (pCi/g), sigma error (%), relative percent difference (RPD), and percent difference (%D) for applicable samples.

2) At the end of each day, print out the worksheet that was completed for that day and place it into a binder labeled "BetaScint Daily Results Log."

6.0 ATTACHMENTS

6.1 Daily Field Laboratory Report

ATTACHMENT 6.1

DAILY FIELD LABORATORY REPORT

BetaScint Inc.

415 North Quay, Kennewick, WA, USA 99336
TEL: (509) 783-4338
FAX: (509) 735-3733
E-MAIL: betascint@owt.com

DATE: ____________, 1999

FAX TO: BetaScint, Inc. Attention: Tom Bayha (509) 735-3733

FROM: Weiss Associates

SUBJECT: Daily Field Laboratory Report

PAGES: ______

---

1. Field Laboratory Location: DOE LEHR Site, Davis, California

2. Contract Reference: 1284005

3. Laboratory Hours: from__________ to __________.

4. Laboratory Conditions:

    a. Temperature:__________

    b. Beta Background:__________

5. BETACON.EXE Settings: Slope_____Intercept_____Background_____

6. Comments:____

Submitted By:____________________ Attachment(s): Daily Test Log ,__________page(s)

BetaScint Daily Results

Sample ID	Start Time	Count Time (Seconds)	Triples	Activity (pCi/g)	1-Sigma Error* (%)	% Difference/ RPD

*1-Sigma Error (%) = $\frac{\sqrt{Triples}}{Triples} \times 100$ $RPD = \frac{Difference}{Mean} * 100\%$ % Difference = $\frac{Measured - True}{True} * 100\%$

Calculate RPD for duplicate analysis

Calculate % Difference for sample 25-4

AQUIFER TESTING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for conducting aquifer testing. Proper testing guidelines and procedures are necessary to ensure effective evaluation of aquifer parameters and characteristics. Additional specific aquifer testing procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *F.G. Driscoll, 1986, Groundwater and Wells, Johnson Filtration Systems Inc., St. Paul, Minnesota*

2.2 *C.W. Fetter, 1988, Applied Hydrogeology, Second Edition, Merrill Publishing Co., Columbus, Ohio*

2.3 *R.C. Heath, 1987, Basic Ground-Water Hydrology, U.S. Geological Survey Water-Supply Paper 2220, Denver, Colorado, pp 34-50*

2.4 *S.W. Lohman, 1979, Ground-Water Hydraulics, U.S. Geological Survey Professional Paper 708, Denver, Colorado, pp 11-56*

2.5 *SOP 5.1 - Water Level Measurements in Monitoring Wells*

2.6 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.7 *SOP 8.2 - Monitoring Well Development*

2.8 *SQP 4.2 - Records Management*

2.9 *U.S. Department of the Interior Water and Power Resources Service, 1981, Ground Water Manual, New York, New York, pp 225-246*

3.0 DEFINITIONS

3.1 Aquifer Testing

Refers to physical testing methods used to determine the hydrologic characteristics of confined or unconfined aquifers. Slug, specific capacity, step-drawdown and constant rate pump tests are commonly used testing methods. Slug tests are conducted by instantaneously changing the water level in a well by adding, removing or displacing a known volume of water and then monitoring the water level recovery in the well.

Specific capacity tests are short-term single-well pump tests that are useful in highly transmissive units, which preclude slug testing. The method consists of measuring the stabilized drawdown in the well while pumping at a constant discharge. Specific capacity tests can be conducted immediately after well development, utilizing the pump used for the development. While less accurate than long-term multi-well pumping tests, the tests provide fast and easy to interpret data for estimating hydraulic conductivity and transmissivity.

Step-drawdown tests are used to estimate well performance, determine a sustainable optimum pumping rate for the well, and estimate aquifer properties. The test is conducted by pumping the well at several successively higher rates and measuring the corresponding water level drawdown.

The constant rate pump test method involves discharging water at a constant rate from a well by pumping and monitoring the corresponding water level drawdown. The recovery of water levels in the well may also be monitored after pumping is terminated (recovery test). Water level monitoring during a pumping and recovery test commonly includes the pumping well and one or more nearby observation wells. In certain instances, observation wells are not available and water level monitoring is limited to only the pumping well.

3.2 Cone of Depression

A depression in the ground water table or potentiometric surface that has the shape of an inverted cone around a well from which water is being withdrawn.

3.3 Confined or Artesian Aquifer

An aquifer that is overlain and underlain by confining layers of lower hydraulic conductivity and, at a given point, the total head of the aquifer is higher than the base of the upper confining layer.

3.4 Drawdown

The difference between the height of the static water level and that of the water level in a well during pumping or water withdrawal. Or, in a confined aquifer, the reduction of the pressure head as a result of the withdrawal of free water.

3.5 Discharge

Volume of water removed per unit of time

3.6 Electric Well Tape or Electric Tape

A water level measuring device that uses a light, or sounds a buzzer, to show that the end of the tape has entered the water. The water in the well completes an electric circuit that turns on the light or sounds a buzzer. The tape is graduated to show the depth.

3.7 Flow Regulator

Flow regulators (flow controllers) are used to control the discharge rate (in volume/time) of water from the well while pumping. The discharge from the mechanical pump is normally set at a constant rate.

3.8 Hydraulic Conductivity

A quantitative measure of the ability of a porous material to transmit a fluid. Also defined as the volume of water that will flow through a unit cross-sectional area of porous material per unit time under a unit hydraulic gradient. Hydraulic conductivity is dependent upon properties of the material and fluid.

3.9 Measuring Point

A fixed and clearly identified point of reference from which water levels in a monitoring well may be measured. It is generally established on the upper rim of the outer protective well casing and has a surveyed location and elevation.

3.10 Mechanical Pump

An electric-powered water pump used to withdraw water from the well during a pumping test.

3.11 Observation Well

A non-pumping well used to observe the ground water levels during pump testing.

3.12 Potentiometric Surface

The surface defined by water levels from multiple tightly cased wells that penetrate an aquifer or hydrogeologic unit. Also, a map of the hydraulic head of an aquifer.

3.13 Pressure Transducer and Data Logger

An electric sensor that can accurately measure hydrostatic pressure. By relating hydrostatic pressure to depth below the water level, the water level can be electronically measured as the transducer is held in the water. Periodic water level measurements can be stored by the data logger for later recall and data evaluation.

3.14 Recovery

The time rate of return to the static water level during a slug test or after cessation of pumping. This is related to the aquifer's response to the change in water level during the aquifer test. After the water level has been raised or lowered by raising or lowering the slugging rod, or after the pump is turned off during a pumping test, the water will return to static conditions (static water level).

3.15 Saturated Thickness

For unconfined aquifers, the interval between the water table and base of the unconfined water bearing unit. For confined aquifers, the interval between the base of the upper confining unit and the top of the lower confining unit.

3.16 Slugging Rod

A large metallic or PVC rod (or cylinder) of known volume that is lowered into the well to displace the water during a slug test. Sometimes called a "pig".

3.17 Specific Capacity

Discharge per unit of drawdown in a pumping well.

3.18 Specific Yield

The ratio of the volume of water that saturated soil or rock will yield under the influence of gravity, per unit volume of the saturated soil or rock. Specific yield is dimensionless.

3.19 Storage Coefficient or Storativity

The volume of water that an aquifer releases from, or takes into storage per unit area of aquifer, per unit change in head. Storage coefficient is dimensionless.

3.20 Transmissivity

A quantitative measure of the ability of an aquifer to transmit water. It is the product of the hydraulic conductivity and saturated thickness.

3.21 Unconfined Aquifer

An aquifer in which the water table forms the upper boundary.

3.22 Water Level

The position of the air-water interface in a well. The water level is usually measured as the depth to the water from a measuring point (such as the top of the outer protective well casing) by the use of a weighted measuring tape or electric sounder. Changes in the water level over time may also be monitored by a pressure transducer installed at a known depth within the water column inside the well. The water level is called the static water level when it is not influenced by well drilling activities, aquifer testing, well development, or ground water sampling.

3.23 Water Table

The saturated zone surface at which the pore water pressure is equal to atmospheric pressure. The water table is the potentiometric surface for an unconfined aquifer.

3.24 Wellhead Flow Meter

A meter installed in the water discharge line near the well head to measure the discharge (in volume/time) of water by the mechanical pump and controlled by the flow regulator.

4.0 PROCEDURE

This section contains responsibilities, requirements and procedures for conducting aquifer testing. Slug, specific capacity, and pump tests are commonly used testing methods to determine the hydrologic characteristics of confined and unconfined aquifers. Consequently, these methods are covered in this section.

All aquifer testing to be conducted at a site must incorporate and be tailored to:

- Known or expected site-specific conditions;
- Targeted parameters to be evaluated; and,
- Analysis methodology(ies) to be conducted with the test data.

Consequently these factors must be considered and the tests designed well before generation of the project work plans and implementation in the field. The project work plans will specify all necessary details to complete the aquifer testing at the particular site. Aquifer testing information and specifications to be included in the project work plans will include, at a minimum, the following:

- Objectives of the aquifer testing;
- Aquifer parameters to be evaluated;

- Type(s) of aquifer tests to be conducted;
- Exact wells to be used for aquifer testing;
- Equipment to be used;
- Type, duration and frequency of measurements to be made; and,
- Additional procedures or requirements beyond those covered in this SOP.

At a minimum the requirements, responsibilities and procedures described in the following section must be incorporated into the aquifer testing to be conducted at each site.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all aquifer testing activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to aquifer testing requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to aquifer testing activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 Slug Test Method

A slug test is an aquifer test in which the water level in a well is instantaneously changed by removing, adding, or displacing a known volume of water. The water level response is monitored over a period of time in the slugged well. The water level response is generally proportional to aquifer transmissivity and hydraulic conductivity.

A known volume of water can be removed relatively rapidly from the well with a submersible pump or bailer. Potable water can be added rapidly to a well by directly dumping from barrels or Baker™ tanks. However, the most common method used in environmental projects involves the insertion and removal of a solid slugging rod (or pig) which instantaneously displaces the water level inside the well.

During testing, water levels may be measured with an electric tape if the wells recharge slowly. However, pressure transducers (with associated data loggers) are more commonly used to measure water levels as they can record a large number of measurements on a more rapid basis. Many brands of transducer/data logger packages have the ability to pre-program the rate of measurement, obtaining frequent measurements during the initial portions of the test and less frequent measurements near the end of the test as the water level slowly stabilizes.

The procedures described below are written for use with a slugging rod and pressure transducer/data logger during slug testing. The procedures also cover both slug insertion and slug withdrawal portions of slug testing. In certain instances only the slug withdrawal test data are used for analysis. However, it is advisable to still conduct the slug insertion test even if only using the withdrawal test data for evaluation of aquifer parameters. The slug insertion test can provide information to make necessary adjustments to the withdrawal test in the field.

The procedures described below are readily adaptable for the other slug testing methods. The project work plans will outline specific slug testing methods and procedures to be used.

4.2.1 Any newly installed wells to be slug tested must be developed before commencement of slug testing activities.

4.2.2 Inspect the equipment to ensure that it is in good working order. Aquifer slug test equipment will vary widely depending on the formation, other site conditions, the diameter and depth of the wells, and the number of the wells to be tested. The project work plans will outline the type of equipment to be used.

4.2.3 All measuring and testing equipment (M&TE) used for field activities will be calibrated by the equipment manufacturer or an approved calibration laboratory using standards which are traceable to the National Institute of Standards and Technology (NIST). Certificates of calibration for M&TE will be obtained from the M&TE supplier and kept in the project files. No M&TE will be utilized without verification of calibration certification.

4.2.4 Decontaminate all downhole equipment according to SOP No. 6.1. In the event that the contaminant histories of the wells to be tested are known or anticipated, the slug tests should be performed starting with the least contaminated well and ending with the most contaminated. Also, it is recommended to cut and remove braided rope or line that has been submerged during slug testing of one well before moving on to another well. These practices will reduce the potential for cross-contamination between wells.

4.2.5 Visually inspect and access the wellhead per SOP No. 5.1.

4.2.6 Obtain a water level depth measurement and sound the bottom of the well according to the procedures outlined in SOP No. 5.1. Compare the measured total depth to the bottom of the well with the well construction diagram to determine if sediment is in the bottom of the well. It is important not to set the pressure transducer in the sediment.

4.2.7 Calculate the height of the water column in the well as follows:

$$(h_1 - h_2) = \text{height of water column in well}$$

where:

h_1 = total depth of well from top of casing (in feet)
h_2 = depth to water from top of casing (in feet)

The height of the water column should be sufficient to totally immerse the slugging rod and also allow concurrent use of a pressure transducer or other measuring equipment during the testing.

4.2.8 Connect the pressure transducer to the data logger. Install the pressure transducer in the water column to a depth that will not interfere with the insertion or withdrawal of the slugging rod during testing, but also not exceed the maximum head limitation of the transducer.

4.2.9 Obtain a barometric pressure measurement if testing (recovery of water level) is expected to take longer than 30 minutes. Station barometric pressure may be recorded from on-site equipment or obtained from a local weather station.

4.2.10 Turn on the pressure transducer/data logger and set the recording frequency (frequency that recorder stores data measured from the transducer and displays a reading) for pre-test monitoring to that specified by the project work plans.

4.2.11 Measure the water level with an electric tape (or equivalent) and record along with the measurement time. Commence pre-test monitoring with the pressure transducer/data logger. The total length of time over which the pre-test measurements are made will be specified in the project work plans. In general, the total time should be roughly equal to or greater than twice the length of time expected to run the slug test.

4.2.12 Once the pre-test monitoring period is ended, remeasure the water level using the electric tape and record along with the measurement time.

4.2.13 Change the recording frequency on the data logger for the slug-in test as specified in the project work plans. Lower the slugging rod to just above the static water level. Concurrently start the data logger and lower the slugging rod as quickly as possible to a depth below the static water level. Record the time of initiation of the test on the appropriate form as outlined in the project work plans.

The slugging rod should be completely submerged. However, it is best to lower the rod only enough to make sure it is submerged and not more. This will reduce the chance of pinching the transducer cables, dragging the transducer, or sticking the rod.

4.2.14 Continue to monitor water level decline with the pressure transducer/data logger, taking periodic water level measurements with the electric tape. Data logger and tape readings should be conducted in accordance with the schedule outlined in the project work plans.

4.2.15 The slug-in test may be terminated once the water level has declined to within 90 percent of the pre-test static, or as specified in the project work plans. Once the slug-in test is terminated, take a physical water level measurement with the electric tape. Record the measurement and time on the appropriate form. Continue on to the slug withdrawal ("slug-out") test.

4.2.16 The slug withdrawal test should not be initiated until the water level has recovered to within 90 percent of static or as specified in the project work plans.

4.2.17 Re-measure the water level using the electric tape and record along with the time.

4.2.18 Change the recording frequency on the data logger to the appropriate frequency of data recording for the slug withdrawal test. The recording frequency will be specified in the project work plans, but may be modified based upon a review of the slug-in test data. Concurrently with starting the data logger, immediately raise the slugging rod as quickly as possible such that the rod is completely out of the water column and above the static water level. Record the test initiation time on the appropriate form as outlined in the project work plans.

4.2.19 Continue to monitor water level rise with the pressure transducer/data logger, taking periodic water level measurements with the electric tape. Data logger and tape readings should be conducted in accordance with the schedule outlined in the project work plans and/or based upon a review of the slug-in test data.

4.2.20 The slug-out test may be terminated once the water level has risen to within 90 percent of the pre-test static or as specified in the project work plans. Once the slug-out test is terminated, take a physical water level measurement with the electric tape. Record the measurement and time on the appropriate form.

4.2.21 The data should be reviewed in the field to help ensure the validity of the test. Complete all documentation on the appropriate form as outlined in the project work plans.

4.2.22 The slug-in and slug-out tests may be repeated as necessary, and as required by the project work plans.

4.2.23 Once all tests are satisfactorily completed for the well, all downhole equipment may be removed and the wellhead secured.

4.3 Specific Capacity Testing

Specific capacity tests are short-term single-well aquifer tests that are useful in highly transmissive units, which preclude slug testing. The method consists of measuring the stabilized drawdown in the well while pumping at a uniform rate. The tests may be conducted in monitoring, extraction and injection wells. Specific capacity tests can be conducted at the end of well development, using the pump utilized for development. While less accurate than long-term multiple well pumping tests, specific capacity tests provide fast and easy to interpret data for estimating hydraulic conductivity and transmissivity in the immediate vicinity of the well being tested.

4.3.1 Newly installed wells to be specific capacity tested must be developed before commencement of testing activities.

4.3.2 Inspect the equipment to ensure that it is in good working order. Specific capacity test equipment may vary widely depending on the formation and site conditions, the diameter and depth of the wells, and the number of the wells to be tested. The project work plans will outline the type of equipment to be used. This step may be skipped if the specific capacity testing is to be conducted immediately after development, using the development equipment.

4.3.3 All measuring and testing equipment (M&TE) used for field activities will be calibrated by the equipment manufacturer or an approved calibration laboratory using standards, which are traceable to the National Institute of Standards and Technology (NIST). Certificates of calibration for M&TE will be obtained from the M&TE supplier and kept in the project files. No M&TE will be utilized without verification of calibration certification.

4.3.4 Decontaminate all downhole equipment according to SOP No. 6.1. If specific capacity testing is to be conducted immediately after development using the same equipment, and the equipment has not been removed from the well site, then the equipment may not have to be decontaminated for the testing.

In the event that the contaminant histories are known or suspected for the wells to be tested, the tests may then be performed starting with the least contaminated and ending with the most contaminated. This will reduce the potential for cross-contamination between wells.

4.3.5 Visually inspect and access the well per SOP No. 5.1.

4.3.6 Obtain a water level depth measurement and sound the bottom of the well according to the procedures outlined in SOP No. 5.1. Compare the measured total depth to the bottom of the well to the well construction diagram to determine if sediment is in the bottom of the well.

4.3.7 Install the mechanical pump in the well using the manufacturer's instructions. Place the pump in the well so that the pump intake is near the bottom of the well screen or location of water entry into the well. Note the height of the water column from the static water level to the pump motor housing and intake. Record all information on the appropriate form as specified by the project work plans. During testing, the drawdown should not be so great as to cause the pump to cavitate.

4.3.8 Immediately prior to turning on the pump, physically measure the water level in the well. Start the mechanical pump and adjust the valve or flow regulator to maintain a constant discharge specified by the project work plan, or as determined from the well development records (see SOP No. 8.2). It is advisable that the discharge rate be sufficient to maintain a stabilized sustainable drawdown of at least 0.1 feet. Record the time of the start of the specific capacity test on forms specified in the project work plans.

4.3.9 Once pumping starts, physically measure the water level decline with the electric well tape (or equivalent) as directed at time intervals specified by the project work plans. Observe and record the wellhead flow meter readings at intervals specified by the project work plan. Record these measurements and the time on the appropriate form.

4.3.10 Once the drawdown appears to stabilize (i.e., the water level under pumping is relatively stable), continue pumping for a sufficient length of time as specified in the project work plans. The criterion for stabilization of water levels and drawdown will be specified in the project work plans.

During this time period, continue to physically measure and record the water levels at intervals stated in the project work plans.

4.3.11 Once the specified time period has elapsed, take a physical water level measurement with the electric tape and shut the pump down. Record the measurement and time on the appropriate form.

4.3.12 The data should be reviewed in the field to ensure that the valid data have been collected. This includes verification that discharge was maintained at a constant rate, and the drawdown stabilized at the minimum required magnitude. Complete all documentation on the appropriate form as outlined in the project work plans.

4.3.13 The specific capacity tests may be repeated as necessary, and as required by the project work plans.

4.3.14 Once all tests are satisfactorily completed for the well, all downhole equipment may then be removed and the wellhead secured.

4.4 Aquifer Pump Test Methods

The pump test methods covered in this section include step-drawdown tests and constant rate pump tests. A step-drawdown test is conducted for the pumping well and is recommended prior to initiation of any constant rate pump test. The data provided by the step drawdown test is used to evaluate well performance and determine the optimum discharge for the subsequent constant rate test.

The step drawdown test entails conducting three or more steps of increased discharge while monitoring water level drawdown. This effectively produces successive stepped drawdown curves. Aquifer testing may potentially be discontinued at a well after the step-drawdown pumping test if: 1) only a single well pumping test is planned; and 2) the step-drawdown test provides all the necessary data of a single well pumping test.

The constant rate pump test method involves the pumping of water from a well at a constant rate, and monitoring the water level drawdown in response to the pumping. Water level recovery may also be monitored after the pumping is discontinued.

Water level monitoring may be limited to the pumping well (single well pumping test) or include one or more nearby observation wells (multiple well pumping test). The single well pumping test utilizes a single well (the pumped well) and a mechanical pump to remove water at a constant rate from the water bearing unit. The same well is used to measure water level drawdown and recovery in the formation.

The multiple well test utilizes one or more observation wells at selected distances and locations relative to the pumping well. Water levels are monitored in the pumping and observation wells throughout the duration of the test.

The remaining discussion provides the requirements and procedures for step-drawdown tests and single and multiple well constant rate pump tests. These represent minimum requirements as site- and project-specific information and criteria must be incorporated in planning and conducting pump tests. The project work plans will provide the necessary additional requirements and procedures for the specific pump tests to be conducted.

The procedures below describe the use of pressure transducers/data loggers to monitor water levels during the pump testing. However, other water level measurement techniques may be substituted and the procedures may be modified as appropriate in the project work plans.

4.4.1 Step-Drawdown Testing

Step-drawdown testing should be conducted before other pump testing. All newly installed wells should be developed before conducting step-drawdown tests.

- Inspect the equipment to be used to ensure that it is in good working order. Equipment used for the step-drawdown testing will vary widely based upon site-specific conditions. The project work plans will outline the type of equipment to be used.
- Measuring and test equipment (M&TE) used for field activities will be calibrated by the equipment manufacturer or an approved calibration laboratory using standards that are traceable to the National Institute of Standards and Technology (NIST). Certificates of calibration for M&TE will be obtained from the M&TE supplier and kept in the project files. No M&TE will be utilized without verification of calibration certification.
- Decontaminate all downhole equipment according to SOP No. 6.1.
- Visually inspect and access the well per SOP No. 5.1.
- Obtain a depth to water level measurement and sound the bottom of the well with the electric tape according to the procedures outlined in SOP No. 5.1. Compare the measured total depth to the bottom of the well to the well construction diagram to determine if sediment is in the bottom of the well.
- Install the mechanical pump in the well using the manufacturer's instructions. The position of the pump intake inside the well should be based upon well construction and site specific factors stipulated in the project work plans. The criteria for placement of the pump in the well should also be contained on the project work plans. Note the height of the water column from the static water level to the pump intake. Record all information on the appropriate form as specified by the project work plans. During testing, the drawdown should not be so great as to cause the pump to cavitate.
- Connect the pressure transducer to the data logger. Lower the pressure transducer inside the pumping well to a depth below the bottom of the anticipated drawdown. The transducer should be installed at a level that: 1) eliminates effects from the pump intake; 2) is below the anticipated water level

during maximum drawdown; and 3) does not exceed the maximum transducer head limitation. In addition, the transducer must be secured inside the pumping well in such a manner that the transducer will not be effected by turbulence from the pump. Record the depth of the transducer.

- Turn on the pressure transducer/data logger, set the recording frequency for pre-test monitoring to that specified by the project work plans. (Data loggers should be placed in a secure location to prevent tampering.)
- Physically measure the water level with the electric tape and record along with the time. Commence pre-test monitoring with the pressure transducer/data logger. The total length of time over which the pre-test measurements are made will be provided in the project work plans. Generally water levels are recorded for a period before the step-drawdown test that is at least twice as long as the time expected for the step-drawdown test and the recovery period. Record the information, including times of measurements, on the appropriate form as specified by the project work plans.
- Once the pre-test monitoring period is ended, remeasure the water level using the electric tape and record along with the time.
- Change the recording frequency on the data logger to the appropriate frequency of step-drawdown data entry as required by the project work plans. Begin recording water level measurements with pressure transducer/data logger as required by the project work plans for the initial pumping phase of the step-drawdown test. Start the mechanical pump and adjust the valve or flow regulator to maintain the constant rate of discharge specified by the project-specific work plan. This rate will be the first step in the step-drawdown test. Record the time of the start of the step-drawdown test as specified in the project work plans.
- Continue to monitor water level decline during the first step with the pressure transducer/data logger, taking periodic water level measurements with the electric tape. Data logger and tape readings should be conducted in accordance with the schedule outlined in the project work plans. As the first step continues, review the water level data and, if necessary, adjust the recording frequency of the data logger. Observe and record the wellhead flow meter readings as required by the project work plans.
- Continue pumping and recording water levels and flow meter readings in the first step as long as required by the project work plans.
- Once the first step is ended, measure the water level with the electric tape and record depth and time. Adjust the data logger as necessary (based upon review of data from the first step) or specified in the project work plans for commencement of the second step of the test.
- Without turning the mechanical pump off, initiate the second step of the test by changing the pumping rate with the valve or flow regulator to the rate specified by the project work plans.

- Monitor the water levels and flow meter readings and continue the second step as described in 4.4.1.13 and 4.4.1.14 above.
- Repeat the cycles of changing pumping rate and recording depth of water as often as is required (for each step of the step-drawdown test) by the project work plans and as described in 4.4.1.15 and 4.4.1.16 above.
- Once the last step is completed, re-set the data logger for the recovery period measurement duration and frequency as specified in the project work plans. Obtain a water level measurement with the electric well tape and record the measurement and time. Shut down the mechanical pump. Record the time (to the nearest 10 sec) that the pump was shut down on the appropriate form.
- Continue to measure and record the water level recovery with the pressure transducer/data logger as long as is required by the project work plans or until the water level has recovered to within 90 percent of the level expected from the pretest trends. Also, continue to take physical water level measurements periodically during recovery. Once the recovery period is ended, take a physical water level measurement at the end of the test. Record the measurement and time on the appropriate form.
- The data should be reviewed in the field to help ensure the validity of the test. The field data review may also be used to determine the discharge rate to be used during the subsequent single or multiple well pump testing. Complete all documentation on the appropriate form as outlined in the project work plans.
- Once the step-drawdown test is satisfactorily completed for the well, the equipment may be left in the well for subsequent single or multiple well pump testing. If the subsequent testing will not be conducted then all downhole equipment may be removed and the wellhead secured.

4.4.2 Single and Multiple Well Constant Rate Pump Testing

The procedures in this section are written as if multiple well pump test is being conducted. However, these procedures are directly applicable to single well testing. The only difference is that testing and measuring equipment are installed only in the pumping well, and water level measurements are also only collected from this well.

- Inspect the equipment to be used to ensure that it is in good working order. Equipment used for the pump testing will vary widely based upon site-specific conditions. The project work plans will outline the type of equipment to be used.
- Measuring and test equipment (M&TE) used for field activities will be calibrated by the equipment manufacturer or an approved calibration laboratory using standards that are traceable to the National Institute of Standards and Technology (NIST). Certificates of calibration for M&TE will be obtained from the M&TE supplier and kept in the project files. No M&TE will be utilized without verification of calibration certification.

- Decontaminate all downhole equipment according to SOP No. 6.1. Equipment maintained inside the pumping well from the step-drawdown test and to be used directly for the subsequent pumping test does not need to be re-decontaminated.
- Visually inspect and access the wells to be used during the pumping test per SOP No. 5.1.
- Obtain a depth to water level measurement and sound the bottom of each well to be used with the electric tape according to the procedures outlined in SOP No. 5.1. Compare the measured total depths to the bottom of the wells to their respective construction diagrams to determine if sediment is in the bottom of the wells.
- If necessary, install the mechanical pump in the pumping well as described in Section 4.4.1.
- If a multiple well test is being conducted, connect the pressure transducers to their respective data loggers. Install the transducers inside the observation wells at this time. The transducers should be installed at a position inside each well that is below the anticipated water level during maximum drawdown, and does not exceed the maximum head limitation. Set up another pressure transducer in an outlying well (outside of the suspected influence of the pumping well) to record station barometric effects, if required. If not already installed from the step-drawdown test, set the pressure transducer inside the pumping well as described in Section 4.4.1. Record the depth(s) of the transducer(s).
- If any transducer cables are run across traffic areas, they must be appropriately protected. Data loggers should also be placed in a secure location to prevent tampering.
- Turn on the pressure transducers/data loggers, set the recording frequencies for pre-test monitoring to that specified by the project work plans. It is also important before initiating pre-test monitoring for the pumping test to ensure that water levels from any previous step-drawdown testing have completely recovered.
- Physically measure the water levels in the pumping and observation wells with the electric tape and record along with the time. Separate data sheets should be used for each well.
- Commence pre-test monitoring with the pressure transducers/data loggers. The total length of time over which the pre-test measurements are made will be provided in the project work plans. Generally water levels are recorded for a period before the pumping test that is at least as long as the time expected for the pumping and recovery period. Record the information, including times of measurements, on the appropriate form as specified by the project work plans.
- Once the pre-test monitoring period is ended, re-measure the water levels in the wells using the electric tape and record along with time.

- Change the recording frequencies in the data loggers for the pumping test as required by the project work plans. Just before starting the pump, begin recording the pressure transducer measurements.
- Start the mechanical pump and adjust the valve or flow regulator to maintain a constant rate of discharge as determined from the step-drawdown test and/or specified by the project work plans. Record pump start time on the appropriate form.
- Continue to monitor water levels during pumping with the pressure transducers/data loggers, taking periodic water level measurements in each of the wells with the electric tape. Data logger and tape readings should be conducted in accordance with the schedule outlined in the project work plans. However, the water level data should be evaluated during the test and, if necessary, the recording frequencies of the data loggers adjusted.
- Observe and record the wellhead flow meter readings as required by the project work plans.
- The project hydrogeologist or designee will determine the time that the mechanical pump should be shut down as specified in the project work plans and/or based on review of field generated drawdown versus time plots from the pumping and observation wells.
- Once the pumping phase is completed, re-set the data loggers for the recovery period recording duration and frequencies as specified in the project work plans. Obtain a water level measurement in each of the wells with the electric well tape and record the measurements and times. Shut down the mechanical pump. Record the time (to the nearest 10 sec) that the pump was shut down on the appropriate form.
- Continue to record the water level recovery in the wells with the pressure transducers/data loggers as long as is required by the project work plans or until the water levels have recovered to within 90 percent of the level expected from the pretest trends. Also, continue to take physical water level measurements periodically during recovery. Once the recovery period is ended, take a physical water level measurement in each well at the end of the test. Enter the measurements and times on the appropriate form.
- The project work plans may require additional depth to water measurements to be physically taken following complete well recovery in order to monitor post test trends in water level. The project work plans will specify the frequency of measurements, and the length of time that the measurements must be taken.
- The data should be reviewed in the field to help ensure the validity of the test. Complete all documentation on the appropriate form as outlined in the project work plans.
- Once the pump test is satisfactorily completed for the wells, all downhole equipment may be removed and the wellheads secured.

5.0 RECORDS

Records generated as a result of this SOP will be maintained in the project records file in accordance with SQP No. 4.2.

6.0 ATTACHMENTS

None

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

SOIL STOCKPILING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for stockpiling of excavated soils. The details within this SOP should be used in conjunction with project work plans. The work plans may present additional project-specific requirements and procedures for soil stockpiling.

2.0 REFERENCES

2.1 SQP 4.2 - Records Management

3.0 DEFINITIONS

None.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all soil stockpiling activities are conducted and documented in accordance with this and any other appropriate procedure. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for the periodic review of field generated documentation associated with soil stockpiling. If perceived variances occur, the PQAS is also responsible for issuing notices of nonconformance and requests for corrective action.

4.1.3 Field personnel assigned to this task are responsible for performing the task according to this SOP and other appropriate procedures identified in the project work plans. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 General

4.2.1 Stockpiling of soils is overseen by various regulatory agencies. Prior to initiating excavation activities, ensure that the procedures and requirements for compliance with applicable federal, state, and local regulations regarding stockpiling of soils have been reviewed and understood. The standard procedures for short-term and long-term stockpiling are described below. The project work plans will also present the following information pertaining to soil stockpiling:

- Any additional requirements or procedures to be followed;
- Equipment to be used; and,
- Stockpile locations.

4.3 Short-Term Soil Stockpiling

4.3.1 Upon initiation of excavation activities, soil will be segregated on a site-specific basis. Potentially clean soils will be stored in a separate short-term stockpile at the site. Soil that is suspected or known to be contaminated will be short-term stockpiled at the site separately from the clean soil.

4.3.2 The short-term stockpiles will be placed upon two layers of impermeable sheeting (such as polyvinyl chloride, polyethylene, etc.). For short-term storage, the separated soils may also be placed in bins or drums for subsequent transport to long-term stockpiles, per the project work plans.

4.3.3 Each pile will be covered with impermeable sheeting at the end of each work day. The covering will be secured at both the top and base of the stockpile. Plastic sheeting will be utilized to limit soil aeration and the release of windborne dust and particulates. The cover will also limit access by rainwater, thus preventing possible contamination of surface water runoff from the stockpile. If bins or drums are used for short-term storage, impermeable sheeting should be used to cover the bins and the covers to the drums should be secured and seated at the end of each work day.

4.3.4 Short-term stockpiling activities will be documented by the Field Coordinator, lead geologist, or lead engineer on the Field Activity Daily Log (FADL) (SOP 1.1) and/or other appropriate form, as specified by the project work plans.

4.4 Long-term Soil Stockpiling

4.4.1 When space and logistics allow, long-term stockpiles will be constructed on a concrete or asphalt base. Two layers of impermeable sheeting will be placed on top of the concrete or asphalt. All sheeting will be folded at joining edges with a three-foot overlap to prevent seepage.

4.4.2 A berm will be erected around each long-term stockpile. Boards or hay bales can be used to construct the berm. The material used to construct the berm will be placed under the two layers of impermeable sheeting to provide containment of any liquids that might leach from the soil.

4.4.3 Soil will be segregated by contaminant type (i.e., separate stockpiles for storage of soils impacted by gasoline, diesel, halogenated hydrocarbons, metals, etc.).

4.4.4 Each stockpile will be visibly labeled.

4.4.5 Covering of each pile with impermeable sheeting will be completed at the end of each work day. The covering will be secured at both the top and base of the stockpile. The sheeting will be utilized to limit soil aeration and the release of windborne dust and particulates. This cover will also limit access by rainwater, thus preventing possible contamination of surface water runoff from the stockpile.

4.4.6 Long-term stockpiling activities will be documented by the Field Coordinator, lead geologist, or lead engineer on the FADL (SOP 1.1) and/or other appropriate form, as specified by the project work plans.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

AMBIENT AIR MONITORING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the collection and documentation of ambient air monitoring samples for chemical analysis and meteorological data. Proper collection procedures are necessary to assure the quality and integrity of all ambient air monitoring samples and meteorological data. Additional specific procedures and requirements are referenced in the SOP Addendum.

2.0 REFERENCES

2.1 *Graseby, 1988, Instruction and Operation Manual – Model PS-1 PUF Sampler, Graseby Inc., Smyrna, Georgia, July 1988*

2.2 *Graseby, GPS-1, Operator's and Instruction Manual – High Volume PM-10 Sampler, Graseby-GMW, Village of Cleves, Ohio*

2.3 *EPA-600/4-89-017, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, U.S. Environmental Protection Agency, Research Triangle Park, June 1988*

2.4 *SOP 1.1 - Chain-of-Custody*

2.5 *SOP 2.1 - Sample Handling, Packaging and Shipping*

2.6 *SQP 4.2 - Records Management*

2.7 *SOP 13.1 - Indoor Air Quality Sampling Using Summa® Canisters*

2.8 *SOP 17.1 - Sample Labeling*

2.9 *SOP 17.2 - Sample Numbering*

3.0 DEFINITIONS

3.1 Air Monitoring

Air monitoring includes the collection of continuous and 24-hr ambient air samples and the collection of meteorological data from the LEHR Site meteorological station. Ambient air samples include particulate, air moisture and volatile contaminant sample collection for both radiological and non-radiological analysis. Air monitoring also includes required maintenance and calibration activities required to operate the air sampling stations and the LEHR Site meteorological station.

4.0 PROCEDURE

This section contains both the responsibilities and procedures involved with the ambient air monitoring program. Proper air monitoring procedures are necessary to insure the quality and integrity of the samples and meteorological data. The details within this SOP should be used in conjunction with project work plans. The project work plans will generally provide the following information:

- Sampling objectives;
- Locations of sampling points or areas;
- Numbers and volumes of samples to be collected;
- Length of sampling periods;
- Additional sampling equipment to be used;
- Types of chemical analyses to be conducted for the samples;
- Specific quality control (QC) sampling required; and,
- Specific procedures to be performed in addition to those covered in this SOP.

The project work plans and this SOP should therefore be reviewed and understood before conducting ambient air monitoring at the Site. As a minimum, the procedures outlined below will be followed.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all air monitoring activities are implemented in accordance with this and any other appropriate procedures. This will be accomplished by staff training and by maintaining quality assurance/quality control (QA/QC). The project managers responsibilities will include:

- Development and updating of sampling procedures;
- Training of LEHR Technical Staff;
- Preparation of sampling schedules;

- Preparation of sampling media;
- Arrange for sample collection and meteorology measurements according to schedule;
- Schedule air sample calibrations and maintenance; and,
- Ensure that sample collection and measures are in accordance with procedures described in this manual.

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to indoor air quality sampling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to indoor air quality sampling activities are responsible for completing their tasks according to this and other appropriate procedures. All staff are responsible for reporting deviations from the procedure to the Field Coordinator or the PQAS. The field personnel responsibilities will include:

- Collection of air samples;
- Calibration and maintenance of air samplers; and,
- Shipment of samples to analytical laboratories.

4.2 Air Sampling Procedures

Air sampling procedures described herein are based on procedures supplied with the air sampler manufacturers. The manufacturers procedures are cited directly whenever possible.

All original calibration and sample collection data sheets are considered to be project records and will be maintained in the project files at LEHR. Photocopies of trip sheets (combined data and chain-of-custody) and calibration sheets will be sent to Weiss Associates and photocopies of the chain-of-custody sheets (where applicable) will be sent to the analytical laboratories.

The calibration equipment must be handled carefully and must be transported and stored in their respective cases. Any nicks or chips to the air intake of the orifices for the GPS-1 or PM10 samplers will require their recalibration at the manufacturer.

4.2.1 Continuous Monitoring of Particulate Radionuclides and Tritium

This procedures governs the continuous collection of particulate air samples using air filters (2-week samples) and tritium as water vapor collected on silica gel columns (4-week samples). Figure 1 provides a schematic of the particulate radionuclide/tritium monitoring assembly.

The total beta and total alpha measurements are made on individual filters after a holding time to allow for the decay of naturally occurring radon and thoron decay products. Individual filters from each location are composited and analyzed for gamma-emitting radionuclides and other specific radionuclides, including Sr., U. and Ra.

Tritium samples are analyzed by distillation of the water from the silica gel, followed by liquid scintillation counting.

A. Equipment: The following equipment will be needed:

<u>Particulate Sampling Equipment</u>

- Filter heads with filters installed by the analytical lab
- Filter holder shipping cooler with metal lids for covers
- Rain guards for filter holders
- Air flow calibrator with current calibration label
- Sample labels
- Sample trip sheet (chain-of-custody)
- Masking tape
- Permanent marker (Sharpie)

<u>Silica Gel Sampling Equipment</u>

- Silica gel column assemblies for tritium sampling
- Caps for the silica gel columns
- 47-mm glass fiber filter holders
- Calibration rotameter for silica gel columns
- Extra 47-mm glass fiber filters for tritium sampler
- Masking tape
- Permanent marker (Sharpie)

<u>Miscellaneous</u>

- Plastic tubing 3/8 and 1/2 inch ID
- Hose clamps and quick connect fittings
- Spare sampling system
- Assorted tools (pliers, screwdriver, wrench, Teflon tape, etc.)

B. Sample Collection Procedure

1. Filter heads and silica gel columns assemblies will be loaded by the analytical lab and shipped to LEHR in a reusable cooler.
2. Leave the air pump turned on during sampling and sample changes.
3. As Found Observations:
    a. Note on the trip sheet any conditions near the sampler that may have affected the air sample, such as construction or farm activities.
    b. Note on the trip sheet any problems with the sampling system.

c. Before disturbing the system in any way, observe the as found tritium flow rate by reading the in-line rotameter. If the sample is scheduled for collection, record the as found flow rate on the trip sheet (note tritium samples are collected on a 4-week basis, air filters are collected every 2-weeks). If the tritium is not scheduled for collection, record the as found flow rate in the comment section of the trip sheet.

4. Removal of Exposed Particle Filter

a. Calibrate (measure the flow rate) the air sampler every time a filter head is changed. Write and identify the number of the calibrator on the trip sheet. Ensure that the calibrator has a valid calibration label. The calibrator will be re-calibrated annually and must not be used if the recalibration date has passed.

b. Measure the as found flow rate for particle samples as follows:
   - Remove the exposed filter head and install the flow calibrator;
   - Reinstall the exposed filter head into the calibrator inlet;
   - Hold the calibrator level and read the flow rate;
   - Record the flow rate as the end flow reading on the trip sheet; and,
   - Read and record the exposure hours from the running time meter.

c. Remove the exposed filter head from the calibrator.

d. Examine the exposed filter. Record any abnormalities, such as excessive moisture, unusual particle loading, clogging due to ice or snow, wrinkles, and tears.

e. Attach the sample label to the side of the filter holder, then place the exposed filter into the shipping container and place a metal cap over the exposed filter. Secure the metal cover with two pieces of masking tape.

5. Installation of New Particle Filter

a. Check to see that the overall sampling system is operating properly. Replace any worn, brittle, or cracked tubing. Check for lose fittings, bad quick disconnect fittings, etc.

b. Attach a fresh filter head (new filter) to the calibrator inlet. Adjust the flow to 1.5 ft^3/min using the controller on the pump.

c. Record the flow rate in the "next flow" column on the trip sheet. Record the location, time on and date on onto masking tape and place on the side of the new filter holder.

d. Remove the calibrator.

e. Reset the running time meter (if possible). Complete the Running Time Meter Log located inside the door of the sampler (see worksheet section).

f. Re-install the new filter head and cover with a rain guard.

6. Removal of Exposed Silica Gel Columns (Tritium Samples)

a. Silica gel columns are only changed once every 4-weeks. Do not remove unless the labels and trip sheets indicate that it is scheduled for removal.

b. Ensure that all columns are tightly sealed and capped. Recheck fittings on tubing for a tight fit.

c. Observe the silica gel column assemble in use. The silica gel near the air inlet should be lighter in color (whiting or a light blue), while silica gel near the outlet should remain dark blue. Note in the comment section how much of the silica gel has changed color (example: one column white or light blue, second column 50% white or light blue). Also note if dirt is collecting in the silica gel, as this may indicate a problem with the air flow, pre-filter, or the column seal.

d. Before disturbing the system in any way, record the as-found flow rate observed on the rotameter on the trip sheet (this should have already have taken place as part of the AS FOUND OBSERVATION section).

e. Record the exposure hours by using the running time meter log on the inside of the sampling hutch. Since the tritium samples are collected over two, 2-week particulate sampling periods, the exposure hours for the tritium sample will be the sum of the running time for the previous particle sampling period plus the running time for the current 2-week particle sampling period. If the running time meter log at the hutch is incomplete the exposure hours can be found from the previous trip sheet (stored at the LEHR Site).

f. Remove all existing column assembly from the pumping system by loosening the metal hose clamps on the inlet and outlet nipples and slipping the tubing off the columns.

g. Place the yellow caps on the assembly inlet and outlet nipples. If caps are not available, seal the openings with several layers of Teflon tape.

h. Attach the sample label to the exposed sample. Masking tape can be first applied to the column and then label attached to the masking tape, if needed.

7. Installation of New Tritium Column Assembly

a. Record location, date, and time on onto masking tape on the new sample assembly.

b. Calibrate (measure using calibrated air flow meter) the pump air flow before attaching the tubing to the outlet of the third column. Proceed if reading is 200 mL/min. Adjust flow with hutch rotameter if reading is different.

c. Calibrate (measure using calibrated air flow meter) the tritium sampler flow to insure a reading of 200 mL/min. If a different flow rate is observed then this is an indication of a leak in the tritium column assembly. Typically, the leak will be located at the lids. Remove one lid at a time and then replace, tighten and re-check the air flow. Continue with all three columns until the flow reads 200 mL/min.

d. Change the 47-mm pre-filter. The exposed filter is not analyzed and can be discarded.

e. Ensure that:

– Hose clamps are reconnected and tight;
– Columns are in a vertical position;

- Rotameter is in a vertical position; and,
- Rotameter is set at 200 ml/min adjustments are made using the needle valve on the rotameter.

f. Complete the trip sheet by entering the exposure hours, time off, and next flow sections of the sheet. Verify that the on date, time on, start flow, and end flow are on the trip sheet. Note any unusual observations on the trip sheet.

8. Equipment Problems (Unusual Conditions)

a. If the air pump or the running time meter is not operating:
- Install the backup sampling system;
- If the running time meter has stopped, but the pump is operating, then calculate the exposure hours from the information on the trip sheet;
- If the sample has more than 168 hours, submit the sample in the normal manner; and,
- If the sampling period is less than 168 hours, contact the Air Monitoring Project Manager to for instruction on submitting the sample.

b. Notify the air project manager if the following tritium sampling problems occur:
- No color change is observed;
- The entire column length for all 3 columns has color change; and,
- The color change pattern is unusual (example: only the 3rd column has changed color, indicates a probable air leak).

C. Shipping for Radiological Particulate and Tritium Samples

The original copy of the trip sheet will be maintained in the project files at LEHR as an official project record. Photocopies will be sent to the analytical lab and to Weiss Associates (Emeryville).

Following sample collection, LEHR staff places the sampling media (filter holder and silica columns) into their original shipping containers along with a photocopy of the trip sheet. Carefully re-pack the shipping container with the original packing material, and ship the samples 2nd Day Federal Express, or equivalent) to the air monitoring project analytical laboratory.

4.2.2 Metals and PM_{10} Using PM_{10} Hi-Vol Sampler.

A Graseby PM_{10} particle size selective inlet high-volume sampling system will be used to collect airborne particulate for metal and dust analysis. Air will be pulled through high purity glass fiber filters at a flow rate of approximately 1.13 m^3/min. The air monitoring program project analytical laboratory will load the filter holders with tared glass fiber filters and ship them to the LEHR Site. LEHR field personnel will collect and document the samples, then ship the samples to the project analytical laboratory for analysis.

A. Calibration: The PM_{10} Hi-Volume air sampling system will be calibrated according to the manufacturer's specifications and procedures (Graseby, 1988).

B. Materials Required: Preloaded filter holder, recorder chart, PM_{10} Data Sheet.

C. Sampling Starting Procedure:

1. Fill out the site location, sample date, sample serial number, sample model number, motor number, volumetric flow controller number, filter ID number, average operating pressure drop, PS (station barometric pressure), and TS (station temperature).
2. On the backside of the flow event recorder chart, record the sampler S/N, sampler location, date and person collecting the sample.
3. Raise the sample inlet (large dome cover). Lock the inlet open using the shelter pan support struts. Inspect the filter screen, remove any dust or foreign material.
4. Inspect the filter for any holes, tears, or creases. One "extra" filter per sample set is included as the trip blank, if a damaged filter is found, use the damaged filter for the blank.
5. Remove the snap on cover on the filter holder. Center the filter holder on the inlet screen. Tighten the four corner wing nuts using alternating pressure.
6. Open the shelter door and recorder door. Install the recorder chart by raising the pen arm and placing the chart center hole over the recorder slotted drive. Lower the pen arm. The chart is advanced by rotating the slotted drive clockwise, until the desired sampling start time is beneath the pointed indicator on the right side of the recorder.
7. Make sure the flow recorder is connected to the motor housing pressure tap and it is properly zeroed (pen rests on the inner most circle of the chart). Adjust the zero by rotating the small set of screws located at the bottom right of the recorder.
8. Turn on the pump motor. Note and record the starting time. Ensure that the recorder pen is inking and indicates that the sampler is operating at its correct set point. No adjustments can be made to the volumetric flow controller sampling rate. If the recorder indicates that the sampler is not operating within three chart divisions of the correct point, check the recorder connections. If the problem persists, call the LEHR Air Project Manager. Appendix D of the Graseby Manual provides additional information on the chart recorder.
9. Reset the running time meter to zero.
10. Close the recorder and shelter doors.
11. Use the direction and math equations given in the look-up table to calculate the actual flow rating. Record the on date, on time, on flow, and complete the trip sheet.

D. Post Sampling Steps:

1. Raise the sampler inlet.
2. Remove the filter cartridge and replace snap on cover.
3. Open the shelter door. Open the recorder door and remove the chart. Examine the chart. The trace should be stable without peaks or interruptions. If possible, provide an explanation of any unusual trace in the comment section on the trip sheet.
4. Record in the comment section of the trip sheet any conditions or activities around the site that may affect the result (construction, farming, extreme weather, etc.).

5. Calculate the samplers operational flow rate:
   a. Calculate the average filter pressure differential (P_a)
   b. Calculate the Pressure Ratio (P_o/P_a)
   c. Use the Look Up Table and Equations to Calculate Flow

      SQ_a, at T_a, and P_o/P_a

      SQ_a is the samplers seasonally adjusted flow rate (m^3/min)
      T_a is the mean of the on and off temperature (°C)
      P_a is the mean of the on and off barometric pressure (mm Hg)
   d. Complete both the field data sheet and the trip sheet (chain-of-custody associated with the sample labels).

E. The original copy of the trip sheet will be maintained in the project files at LEHR as an official project record. Photocopies will be sent to the project analytical lab and to Weiss Associates (Emeryville).

The metals and PM_{10} samples must be stored in a dry secure location until shipment.

The sampling modules and photocopies of the data will be placed in a cooler and shipped next day air express to the air monitoring project analytical laboratory.

4.2.3 Chlordanes Using GPS-1 Sampler (U.S. EPA TO-4)

Samples will be collected using EPA Method TO-4. A Graseby GPS-1 high volume air sampler will be used to pull ambient air through a glass fiber filter followed by a PUF cartridge at flow rates of 200-280 L/min. Field Personnel will collect and document the samples and ship the samples to the analytical laboratory.

D. Calibration and Maintenance: The high-volume chlordane sampling system will be calibrated and maintained according to the manufacturer's specifications and procedures (Graseby, GPS-1).

E. Materials Required: Preloaded sampling head, data sheet (trip sheet), blue-ice, cooler, plastic bags, aluminum foil.

F. Sample Collection

1. Use the trip sheet for recording the sample collection information. All portions of the sheet must be completed including air sampler number, date, on-time, on-flow, off-time, off-flow, elapsed time-on, elapsed time-off, and signature.
2. Open the cover of the GPS-1 housing. Remove the sampling head from its plastic-shipping bag. Remove aluminum foil from the bottom of the sampling head and store in plastic shipping bag. Install the sampling head on GPS-1 intake (pipefitting). Push down on the release levers to lock the sampling head to the GPS-1.
3. Release the three swing bolts of the top of the 4" filter holder and remove the aluminum cover plate using care not to touch the clean filter. Inspect the filter for damage and change, if necessary. Place the cover into the plastic shipping bag and

store inside the sampler housing. Re-tighten the three swing bolts using sufficient pressure to prevent air leaks. Close the cover of the GPS-1 housing.

4. Turn on the air sampler. Record the on-time and elapsed timer readings. Gradually adjust the ball valve to obtain a reading of 50" on the magnehelic gauge. Allow the system at least 5 minutes, then record the magnehelic gauge reading.
5. The magnehelic gauge, date, elapsed time, and time of day of the readings should be documented at least once every day that the sampler is running.
6. At the end of the sampling period the final magnehelic gauge reading, date, elapsed timer, and off-time must be documented. Turn the power off. Re-install the aluminum cover plate on the sampling head. Remove the sampling head by pulling up on the release levers. Cover the bottom of the sampling head with the stored aluminum foil and place the sampling head into the plastic bag.
7. Place the plastic bag containing the sampling head into a cooler filled with blue-ice. Sample heads must be stored on blue-ice or in a freezer.
8. The sampling heads will be disassembled by Weiss staff. PUF plugs will be placed into clean wide-mouthed jars, labels will be attached to the jars. Filters will be placed into oven-baked aluminum foil packets, the foil packet and the label will be placed into a ZipLock bag. The samples will be placed into a cooler with blue- or dry ice and shipped next day air express to the air monitoring project analytical laboratory.

D. Shipping for Chlordane Samples

The original copy of the trip sheet will be maintained in the project files at LEHR as an official project record. Photocopies will be sent to the analytical lab and to Weiss Associates (Emeryville).

The chlordane samples are affected by heat (volatilization of material may occur) and must be stored in a dry secure location near 0ºC unless they are immediately shipped.

The sampling modules and photocopies of the data sheets will be placed in a cooler containing blue-ice and shipped next day airmail to the air monitoring project analytical laboratory.

4.2.4 Volatile Organic Compounds Using U.S. EPA TO-14 (Summa Cans)

Samples will be collected using a method similar to U.S. EPA Method TO-14. The analytical laboratory will ship pre-cleaned Summa canisters and airflow controllers to the LEHR Site. Field personnel will collect and document the samples and ship the sampling canisters to the laboratory.

A. Calibration and Maintenance: The TO-14 sampling system should require no field calibration or maintenance.

B. Materials Required: Project analytical laboratory supplied 6-liter Summa canisters, flow controllers and pre-filters.

C. Sample Collection

1. Flow controllers and pre-filters will be attached to the Summa canisters according to the instructions of the analytical laboratory using Swagelok fitting.
2. The VOC samples can be easily contaminated from site activity so begin the VOC sampling at the end of the ON visit to the station and end the VOC sampling at the beginning of the OFF visit to the station. Do not operate an automobile near the sampling station.
3. Sampling canister will be placed on the sampling deck with the flow controllers attached. The flow controller valve will be opened and the time, date, and estimated flow ON will be noted on the trip sheets
4. Leave the site following beginning of sampling.
5. After 24 hours, return to the site and close the sampling valve before conducting any other sampling activity. Record the time, date, and estimated flow OFF on the trip sheet.
6. Disconnect the flow controllers and re-pack and the Summa canisters in their original shipping containers.

D. Shipping

The original copy of the trip sheet will be maintained in the project files at LEHR as an official project record. Photocopies will be sent to the analytical lab and to Weiss Associates (Emeryville).

These samples will be sent 2^{nd} Day Federal Express to the Air Monitoring Project Analytical Laboratory.

4.2.5 Radon Alpha Track Passive Samplers

Air samples for radon will be collected using Landauer Radtrak DRNF radon detectors. These detectors are purchased directly from Landauer and the analytical cost is included in the initial purchase price. Samples will be collected over a 3-month period, with the duplicate samples at each location. In addition, one Radtrak out of each lot will be submitted as a blank.

E. Calibration and Maintenance

There should be no field calibration or maintenance required for the Radtrak detectors. Security and custody inspection should be made on the Radtrak devices using the same procedures and documentation as for the LEHR Site external radiation detector (TLD).

F. Materials Required: Radtak detectors from Landauer in sealed aluminum bags.

G. Deploying Detectors

1. Radtrak detectors are supplied in sealed aluminum bags to prevent radon exposure (DO NOT OPEN THE ALUMINUM BAG PRIOR TO THE SAMPLING EVENT).

2. Open the aluminum bag and remove a clear plastic cup containing the Radtrak fastened to the bottom. There should be five Radtrak detector per bag.

3. Fill in the Landauer supplied Detector Log Sheet and the Weiss Associates supplied trip sheet with:
   a. Air Sampling Station Number (AM-2, AM-3, AM-5, or AM-6; use AM-10 for the blank samples);
   b. Date and time installed; and,
   c. Radtrak serial number (this is the number beside the bar code).

4. Install the plastic cup into the field canister. The cup is placed upside down with the Radtrak exposed to the ambient air. Secure the cup in place using the retaining system designed by Dames and Moore.
   - Note: The field canisters (holders for the plastic cups) should be installed at a uniform height at each air station with the inlets as close to 2-m as practical. The field canister can be attached to the existing posts, or attached near the LEHR Site external radiation detectors (TLD), if TLD are deployed at the air sampling location.

H. Removal of Deployed Detectors

1. At the end of the monitoring period (3 months exposure), remove the Radtrak detector from the plastic cup. Peel off the gold seal provided from Landauer and use the gold seal to cover all the holes on top of the detector. This stops the monitoring period.

2. Record the ending date and time on the Landauer supplier Detector Log Sheet and the Weiss Associates supplied trip sheet.

I. Collection of Blank Samples

1. One Radtrak detector out of each lot of five detectors will be stored and analyzed as a blank sample.

2. Carry out the blank Radtrak detector along with the rest of the detectors during deployment of the actual samples.

3. Remove the blank Radtrak detector and place the Landauer supplied gold seal on top of the detector (covering all the holes).

4. Place the gold-sealed Radtrak into an air tight screw-cap jar. Apply custody tape.

5. Label the jar with the date, time, Radtrak serial number.

6. Store the blank Radtrak in the jar during the 3 month sampling period.

7. At the end of 3 months, remove the Radtrak and ship to Landauer with the actual samples.

J. Shipping

Keep the original copies of both the Landauer supplied Detector Log Sheet and the Weiss Associates supplied trip sheet in the Project Records at the LEHR Site. Ship photocopies of the data sheets.

Ship to Radtrak detectors, a copy of the Landauer supplied Detector Log Sheet, a copy of the Weiss Associates supplied trip sheet to:

Landauer, Inc.
2 Science Road
Glenwood, Illinois, 60425-1586

There should be a Landauer supplied shipping label.

A copy of the Weiss Associates supplied trip sheet and the Landauer supplied Detector Log sheet should be forwarded to Weiss Associates.

4.2.6 Meteorological Tower Data Download Procedure

These procedures will be used to transfer data from the data logger connected to the meteorology tower to a lap top computer containing MicroMet Report Software.

K. Equipment needed:

- Data logger (attached at the stationary Met station);
- Windows 95 compatible computer;
- MicroMet Report Software;
- RS232 serial cable (9 pin x 25 pin); and,
- 3.5 inch, 1.4 Mb floppy disk

L. Downloading Data from Met One Station to a Lap Top Computer

Meteorological data should be downloaded on a monthly basis. Sometime during the first week of each month, download all new data from the meteorological station and send the data file to Weiss Associates (Emeryville).

1. Before powering up the laptop, plug the RS-232 cable (9-pin) into the serial port of the laptop computer. Attach the other end of the cable (25-pin) to the data logger port. Use a 9-pin to 25-pin adapter if needed. Power up the laptop with the pre-installed MicroMet Report Software.
2. Launch the MicroMet Plus V2.2 Console Program. Go to the "Connect" sheet tab, and click the "Monitor" button on the right hand/center of the screen. Real-time data should be displayed. If there is no response double check the cable connections. If this doesn't work, there may be a problem with the "System" sheet. In that case, contact the air monitoring project manager.

3. Once it has been determined that the laptop is communicating with the met station, click the "Retrieve" button. This should be all that is required to retrieve the data.

4. To confirm the data download, go to the "Data" tab-sheet. On the right side of the page is the "Short Period Average" spreadsheet. At the top of that spreadsheet, click the "Fast-Forward" icon to jump to the last record, and confirm that data has been collected for the whole month. Disconnect the laptop and close-up the met-station.

M. Exporting Met Data

1. Upon returning to the office, launch the MicroMet Plus V2.2 Console Program.

2. Go to the "Data" tab-sheet. On the right side of the page is the "Short Period Average" spreadsheet. At the top of that spreadsheet, click the icon that looks like a floppy-disk to Export Data.

3. Using the calendar button, select the date range "From:" the first day of the previous month, "To:" the last day of the previous month (For data collected the first week in January you would select "From:" 1997/12/1 "To:" 1997/12/31). Click "OK".

4. There will probably be a "Text greater than 32k" error. Click "OK" and ignore it.

5. Go to the "C:\MICROMET\WEISS1\EXPORT\" subdirectory. The file name will correspond to the date of the data saved (i.e. 97120131.txt for December 1-31, 1997). This file should be sent to the air monitoring project manager via email.

6. The meteorological data should be exported to Weiss Associates (Emeryville) on a quarterly basis for backup Use a compression program, such as "WinZip", to save both the "Weiss1" and the "System" folders, together with the three "Deisl*.isu" (*=1,2, & 3), into a single file. Then email that file to the air monitoring program manager.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Example Air Monitoring Chain-of-Custody

6.2 Air Sampling Station Meter Log

6.3 Alpha Track Passive Sampler Chain-of-Custody

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

EXAMPLE AIR MONITORING CHAIN-OF-CUSTODY

*** * EXAMPLE * ***

CHAIN OF CUSTODY # ____

WA Weiss Associates, Emerville office

CONTACT: Pleasant McNeel

Emeryville: (510) 450-6147

Analyses Requested: **Alpha/Beta**

Media: **Air Filter**

Type: **Air Particulate**

ANALYSES LAB: **GEL**

LEHR	Data			Comments
Sample ID:	**AA000**		**SCFM**	METER READING:
* **ON** DATE/TIME/FLOW RATE:				Previous:
** **OFF** DATE/TIME/FLOW RATE:				TOTAL HOURS:
New Filter Flow Rate				
Filter color:				
Sample ID:	**AA000**		**SCFM**	METER READING:
* **ON** DATE/TIME/FLOW RATE:				Previous:
** **OFF** DATE/TIME/FLOW RATE:				TOTAL HOURS:
New Filter Flow Rate				
Filter color:				
Sample ID:	**AA000**		**SCFM**	METER READING:
* **ON** DATE/TIME/FLOW RATE:				Previous:
** **OFF** DATE/TIME/FLOW RATE:				TOTAL HOURS:
New Filter Flow Rate				
Filter color:				
Sample ID:	**AA000**		**SCFM**	METER READING:
* **ON** DATE/TIME/FLOW RATE:				Previous:
** **OFF** DATE/TIME/FLOW RATE:				TOTAL HOURS:
New Filter Flow Rate				
Filter color:				
Sampled by/date:				Relinquished by/date:
Received by/date:				Relinquished by/date:
Received by/date:				Relinquished by/date:

Return New Filters to:

Attention: Kim Warren-WA, or John Wolf-WA

PHONE: (530) 752-1348 or 8794

Institute of Toxicology & Environmental Health

FAX: (530) 752-6918

University of California, Old Davis Rd., 1 Shields Ave., Davis, CA 956-8615

* **ON** DATE/TIME/FLOW RATE: New filter is installed, flow rate is documented.

** **OFF** DATE/TIME/FLOW RATE: flow rate is documented before 2 week sample is removed.

ATTACHMENT 6.2

AIR SAMPLING STATION METER LOG

LEHR AIR SAMPLING METER LOG: Alpha/Beta Sampling

Station # __________ : __________

Date	End Time	Sample I.D.# AA000	Time Meter	Comments

ATTACHMENT 6.3

ALPHA TRACK PASSIVE SAMPLER CHAIN-OF-CUSTODY

Radtrak Alpha Track COC

COC-__

Company	Weiss Associates
Billing	5500 Shellmound Street
Address	Emeryville, CA 94608
Phone	530-752-7777
Contact	Kim Warren
Account #	0408904 (LEHR Task 128-4001-272)

(708) 755-7911

Landauer, Inc.

2 Science Road

Glenwood, IL 60425-1586

Detector Number	Starting Date MO/DAY/YR			Ending Date MO/DAY/YR			Exposure Days	Detector Location/Comments Time of Exchange/New Detector Number

Standard Operating Procedure (SOP) Addendum

SOP for Total Alpha/Beta Air Station

Grab samples for total alpha/beta analyses are conducted on a biweekly basis. The operation and sampling procedure for the alpha/beta air system is the same as the previous air sampling SOP. The airflow required for total alpha/beta sampling remains at 1.5 standard cubic feet per minute (scfm) or 90 standard cubic feet per hour (scfh).

Attach proper glass filter to the sampling head. Open valve D and flow meter valve until vacuum gauge reads less than 10"Hg (note minor adjustment is made on the flow meter valve to ensure proper flow at 90 scfh once valve D is opened). Adjust the flow meter valve until it reads 90 scfh and check that valves A, B, and C are fully shut during air sampling activity..

SOP for Tritium Air Station

Grab samples for tritium analyses are conducted on a monthly basis. The operation and sampling procedure for the tritium air station is similar to the previous air sampling SOP. The airflow required for the tritium analysis remains at 200 mL/min or 0.42~0.45 scfh on the flow meter. Due to the low airflow required for the tritium sample, the life expectancy of the pump will be shortened significantly. Therefore, valve C has been incorporated to draw ambient air into the pump to alleviate high vacuum caused by the low flow rate.

Attach silica gel columns to the air station and open valve D while adjusting the flow meter valve until it reads between 0.42~0.45 scfh. Make sure valves A and B are fully shut during air sampling. Open valve C slightly (a hissing sound can be heard when valve C is opened) until vacuum gauge reads less than 10"Hg. Adjustment must be made on both flow meter valve and valve C to ensure airflow is between 0.42~0.45 scfh.

SOP for Total alpha/beta Air Station Leak Test

Leak test for total alpha/beta air station should be performed before the start of every sampling period. The plumbing setup for alpha/beta is configured into two sections (Figure 1). Section 1 begins from the sampling head down toward the flow meter; sections 2 starts from the flow meter and ends on the vacuum pump. Prior to the inception of the leak test, inspect the sampling train for damages or loose fittings which might cause air leakage. After replacing or repairing damaged parts and confirming all connections are tight, perform the leak test as follows:

1. In order to perform leak test on section 1 of the sampling train, leak test on section 2 must be tested first. The leak test for section 2 of the sampling train begins by turning off valves B, C, and the flow meter valve on the sampling station.

2. Turn on the pump and wait until vacuum gauge reads 20"Hg or greater. Turn valve D off and observe any pressure decrease from the vacuum gauge. If the gauge indicates small increments of pressure drop over time, re-tight all connections and check all valves are fully

closed. If the vacuum gauge still shows decrease in pressure, contact WA task leader immediately.

3. If the vacuum pressure remains constant then proceed to section 1 of the leak test. With the vacuum pump turned off and all valves still closed, remove the glass filter from the sampling head and secure duct tape or apply palm over the opened sampling head. This will serve as an airtight seal during section 1 of the leak test.

4. Turn on the vacuum pump and open only the flow meter valve. Close valve A and wait until gauge indicates 20"Hg or greater for the entire system. Close valve D and observe the vacuum gauge for decrease in vacuum pressure. Note that vacuum pressure will decrease a little during this step. If the gauge indicates pressure decrease, check for any uncovered sampling headspace. If vacuum gauge continues to show pressure drop, contact WA task leader immediately.

SOP for Tritium Air Station Leak Test

Leak test for the tritium air station should be performed before the start of every sampling period. The configuration for the tritium station is similar to the alpha/beta station (Figure 1). The leak test procedures are the same for section 2 of the sampling train. Please refer to *SOP for Total Alpha/beta Air Station Leak Test.*

1. If the vacuum pressure remains constant from section 2 then proceed to leak test for section 1. With the vacuum pump turned off and all valves still closed, remove the pre-filter from the inlet and secure duct tape or palm across the opened inlet (note the tritium columns are still attached to the sampling train). This will serve as an airtight seal during this portion of the leak test.

2. Turn on the vacuum pump and open the flow meter. Wait until the gauge reads 20"Hg or greater and close valve D. Observe the vacuum gauge for any decrease in vacuum pressure. If pressure decrease exists, check for any uncovered inlet space and repeat this step.

3. If pressure continues to drop, remove the tritium columns from the sampling train and secure duct tape or palm to the inlet after the tritium columns. Repeat step 2.

4. If vacuum gauge continues to show pressure decrease, contact WA task leader immediately. Otherwise, if vacuum pressure remains constant, replace the tritium columns because they are the source of leakage.

Standard Operating Procedure (SOP) Addendum
General Information

Job Name: LEHR Air Monitoring Program

Project ID: 128-4004-290

WA Task Leader: Jason Tseng, 510-450-6194

Contents:

a) SOP for Total alpha/beta Air Station
b) SOP for Tests Tritium Air Station
c) SOP for Total alpha/beta Air Station Leak Tests
d) SOP for Tritium Air Station Leak
e) Figure 1. Total alpha/beta and Tritium Air Station Configuration

Scope of Work:

In addition to air sample collection during removal action for radionuclides and tritium, leak test for both trains are required prior to every sampling period.

HOLLOW STEM AUGER DRILLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for field personnel to use during the supervision of drilling operations involving hollow stem auger techniques. Additional specific hollow stem auger drilling procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *SOP 3.2 - Subsurface Soil Sampling While Drilling*

2.2 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.3 *SOP 6.2 - Drilling and Heavy Equipment Decontamination*

2.4 *SOP 8.1 - Monitoring Well Installation*

2.5 *SOP 8.3 - Borehole and Well Abandonment*

2.6 *SOP 10.1 - Soil Organic Vapor Sampling*

2.7 *SOP 10.2 - Cone Penetration Testing and HydroPunch Ground Water Sampling*

2.8 *SOP 15.1 - Lithologic Logging*

2.9 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Hollow Stem Auger Drilling

3.1.1 A drilling method using rotating auger flights (typically in 5 foot joints) with a bit on the bottom of the lead flight (sometimes called the "lead auger"). The flights consist of a hollow pipe and an outer spiral plate, which when rotated, forces soil cuttings upward along the borehole wall to the surface. The auger string is advanced by rotation, with pressure exerted by the rig, forcing the bit to cut the soil at the bottom and direct cuttings to the augers.

3.1.2 A retractable plug with a pilot bit is placed at the bottom of the auger string to prevent cuttings from entering the hollow stem. When the plug is retracted, a sampler may be sent through the hollow center to sample soil at the bottom of the borehole without requiring the augers to be removed. A wireline sampler may also be attached to the inside of the lead auger for coring as the borehole is advanced.

3.1.3 This method is commonly used for drilling and sampling of soil borings, collection of soil gas and screening-level water samples, and installation of some smaller diameter wells. The well casing string may be placed through the hollow stem.

3.1.4 The hollow stem auger drilling method has advantages over other drilling techniques in certain circumstances, and disadvantages in others. This method is highly suitable for unconsolidated and consolidated fine-grained soils. Hollow-stem auger drilling can achieve the most rapid rates of penetration in soft sticky clay-dominated soils. However, coarse and consolidated gravels and hard bedrock may be too dense for adequate drill penetration. Soil cuttings are typically disaggregated and remolded, making bedding, fabric, and soil property determination difficult.

3.1.5 The most reliable method for logging of soils during hollow stem auger drilling is by collecting relatively intact samples through the hollow stem. An advantage of the hollow stem auger method is that soil samples can be readily obtained from the bottom of the hole without requiring the removal of the auger string (unlike air or mud rotary methods).

3.1.6 This drilling method may be used to install monitoring wells (limited by diameter) as there is good depth control, and the auger can be progressively pulled as well construction materials are added to the borehole. The methodology may also be used to drill out monitoring wells for abandonment.

3.1.7 Another advantage of the hollow stem auger method is that air or mud are not required as circulating media. Therefore, there is limited to no potential for flushing of soil samples collected for chemical analyses, and a reduction in volumes of investigated derived wastes requiring costly handling and management procedures. Auger-type rigs can be significantly smaller than other types of rigs, making them the most suitable for some jobs with significant space constraints, including overhead clearance.

3.1.8 Additional disadvantages of the hollow stem auger method include a typical maximum depth of 100 to 200 feet (may be less depending on soil conditions). Hard soil horizons or very coarse gravel (cobbles and boulders) may be impenetrable with this method.

4.0 PROCEDURE

This section contains responsibilities, procedures and requirements for hollow stem auger drilling. The selection and implementation of hollow stem auger drilling techniques must incorporate site specific conditions and requirements. Consequently, the project work plans will identify the following:

- The purpose of each borehole (e.g., to install monitoring well, soil sampling, well abandonment, etc.)
- Specific methodology for drilling, including equipment and cuttings/fluid containment
- Specific locations, depths, and diameters of boreholes
- Objectives and types of sampling and/or logging of borehole
- Details of mobilization/demobilization and decontamination of equipment
- Appropriate health and safety guidelines and personnel protective equipment
- Additional procedures or requirements beyond those covered in this SOP

4.1 Responsibilities

4.1.1 The Field Coordinator is responsible for ensuring that all hollow stem auger drilling activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to hollow stem auger drilling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to hollow stem auger drilling activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 Rig Decontamination and Preparation

4.2.1 All drilling and sampling equipment should be decontaminated before drilling as per SOP Nos. 6.2 and 6.1, and the project work plans.

4.2.2 The driller and rig geologist/engineer should inspect the drilling equipment for proper maintenance and appropriate decontamination prior to each time the rig is mobilized to a site. All clutches, brakes and drive heads should be in proper working order. All cables and hydraulic hoses should be in good condition. All auger joints and bits should also be in good condition (e.g., no cracked or bent blades, bits are not excessively worn, etc.).

4.2.3 Any observed leakage of fluids from the rig should be immediately repaired and the rig decontaminated again before it is allowed to mobilize.

4.3 Site Preparation

4.3.1 The logistics of drilling, logging, sampling, cuttings/fluid containment, and/or well construction should be determined before mobilizing. The site should be prepared as per the project work plans.

4.3.2 Before mobilization, the Field Coordinator and/or the rig geologist/engineer should assess the drilling site with the driller. This assessment should identify potential hazards (slip/trip/fall, overhead power lines, etc.), and determine how drilling operations may impact the environment (dust, debris, noise). Potential hazards should be evaluated and corrected, or the borehole location changed or shifted, as per the project work plans.

4.3.3 The Field Coordinator or appropriate designee should ensure that all identifiable underground utilities around the drilling location have been marked, and the borehole location appropriately cleared per the project work plans. At a minimum, copies of the site clearance documents should be kept on-site.

4.4 Mobilization and Set-Up

4.4.1 Once the site is prepared, the rig is mobilized to the site and located over the borehole location. The rig is leveled with a set of hydraulic pads attached to the front and rear of the rig. The driller should always raise the mast slowly and carefully to prevent tipping or damaging the rig, and avoiding obstructions or hazards.

4.4.2 Appropriate barriers and markers should be in place prior to drilling, as per the site health and safety plan. Visqueen (plastic) may be required beneath the rig.

4.4.3 Appropriate cuttings and other investigation-derived waste containment should be set on site prior to commencement of drilling.

4.5 Health and Safety Requirements

4.5.1 Tailgate Safety Meetings should be held in the manner and frequency stated in the health and safety plan. All Contractor and subcontractor personnel at the site should have appropriate training and qualifications as per the health and safety plan.

4.5.2 During drilling all personnel within the exclusion zone should pay close attention to rig operations. The rotating auger blades can snag or catch loose clothing and literally screw someone into the ground.

4.5.3 Establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The entire crew should be made aware to inform the rig geologist/engineer of any unforeseen hazard, or when anyone is approaching the exclusion zone.

4.6 Breaking Ground

4.6.1 Prior to the commencement of drilling, all safety sampling and monitoring equipment will be appropriately calibrated per the project work plans.

4.6.2 The rig geologist/engineer should inform the driller of the appropriate equipment (e.g., cookie cutter, etc.) to be used for penetration of the surface cover (e.g., asphalt, concrete, cement, etc.). In the event of breaking ground where a shallow subsurface hazard may exist (unidentifiable utility, trapped vapors, etc.), the driller should be informed of the potential hazard and drilling should commence slowly to allow continuous visual inspection and/or monitoring, and if necessary, stop for probing.

4.7 Borehole Drilling

4.7.1 During drilling operations, and as the borehole is advanced, the rig geologist/engineer will generally:

- Observe and monitor rig operations;
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance;
- Prepare a lithologic log from soil samples or cuttings;
- Supervise the collection of, and prepare soil, soil vapor, and ground water samples; and,
- As drilling progresses the rig geologist/engineer should observe and be in frequent communication with the driller regarding drilling conditions. This includes relative rates of penetration (indicative of fast or slow drilling) and chattering or bucking of the rig. These conditions, including the relative drilling rate, should be recorded on the boring log per SOP 15.1. Drilling should not be allowed to progress faster than the rig geologist/engineer can adequately observe conditions, compile boring logs, and supervise safety and sampling activities.

4.7.2 The rig geologist/engineer should also observe the rig operations, including the make-up and tightening of connections as additional auger joints are added to the auger string. Any observed problems, including significant down time, and their causes are recorded on the Field Activity Daily Log (FADL) (SOP 1.1).

4.7.3 Cuttings and fluids containment during drilling should be observed and supervised by the rig geologist/engineer, as per specifications in the project work plans.

4.7.4 The rig geologist/engineer will oversee or conduct appropriate health and safety sampling and monitoring. If any potentially unsafe conditions are evident from the above drilling observations and the health and safety sampling and monitoring, the rig geologist/engineer may suspend drilling operations at any time and take appropriate actions as per the health and safety plan. In the event suspension of drilling activities occur:

- The Field Coordinator or Project Task Leader must be informed of the situation;
- Appropriate corrective action must be implemented before drilling may be continued; and,
- The observed problem, suspension, and corrective action are entered on the FADL.

4.7.5 During drilling the rig geologist/engineer will compile a boring log as per SOP No. 15.1. The log will be compiled preferably from soil samples recovered while drilling as directed in the project work plans. Observations of drilling conditions are also entered on the log as discussed above and in SOP No. 15.1. If total depth was reached prematurely due to refusal, the cause of refusal should be noted on the boring log and the FADL.

4.7.6 Subsurface soil samples may be collected with a split spoon sampler or Shelby tube during drilling per SOP No. 3.2. The sampling will be supervised by the rig geologist/engineer. Soil samples (drive samples) can be readily obtained at discrete intervals with these methods.

4.7.7 Soil organic vapor (SOV) sampling may be conducted at discrete intervals during hollow stem auger drilling. This is done by stopping at the desired depth and driving a sample probe through the hollow stem into the soil ahead of the bit and then collecting a vapor sample. The sampling should be supervised by the rig geologist/engineer following procedures in SOP No. 10.1.

4.7.8 Ground water screening (grab) samples can be obtained at discrete intervals during drilling. One method is to auger to the bottom of the selected interval or zone and pull the auger back to the top of the interval, allowing ground water through the open borehole. A water sample is then collected with a bailer run through the inside of the augers. Another method is to stop the augers at a selected interval or zone and advance a hydropunch sampler beyond the lead auger to retrieve a water sample. The ground water screening sampling procedures should essentially follow those described in SOP No. 10.2.

4.7.9 Borehole Abandonment: If the borehole is to be abandoned once drilling is completed, the abandonment will follow procedures outlined in SOP No. 8.3. The abandonment will be supervised by the rig geologist/engineer.

4.7.10 Monitoring Well Completion: If a monitoring well is to be installed in the borehole, the well completion will follow procedures outlined in SOP No. 8.1. The well installation activities will be supervised by the rig geologist/engineer.

4.8 Demobilization/Site Restoration

After drilling, sampling, well installation or borehole abandonment is completed the hollow stem rig is rigged down and removed from the borehole location. The demobilization/site restoration will be supervised by the rig geologist/engineer or appropriate designee.

4.8.1 All debris generated by the drilling operation will be appropriately disposed.

4.8.2 The site should be cleaned (ground washed if necessary) and surface conditions restored as per the project work plans.

4.8.3 All abandoned borings should be topped off and completed as per the project work plans. All monitoring wells will also have their surface completions finished as per the project work plans.

4.8.4 Any remaining hazards as a result of drilling activities will be identified and appropriate barriers and markers put in place, as per the health and safety plan.

4.8.5 All soil cuttings and fluids will be properly contained, clearly labeled, and maintained as per the project work plans.

4.8.6 The Field Coordinator or appropriate designee should inspect the site to make sure that post-drilling site conditions are in compliance with the project work plans.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be maintained in the Project Records file in accordance with SQP No. 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

MUD ROTARY DRILLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for field personnel to use during the supervision of drilling operations involving mud rotary techniques. Additional specific mud rotary drilling procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *SOP 3.2 - Subsurface Soil Sampling While Drilling*

2.2 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.3 *SOP 6.2 - Drilling and Heavy Equipment Decontamination*

2.4 *SOP 8.1 - Monitoring Well Installation*

2.5 *SOP 8.3 - Borehole and Well Abandonment*

2.6 *SOP 15.1 - Lithologic Logging*

2.7 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Mud Rotary Drilling

3.1.1 A drilling technique that uses a fluid, usually water with bentonite or polymer, pumped down through drill pipe and out through a rotating drill bit attached to the lower end of the drill string. This "mud" mixture cools the drill bit, jets cuttings away from the bit face and flows upward in the annular space between the borehole and the drill pipe, carrying the cuttings in suspension to the surface.

3.1.2 A similar drilling technique referred to as "reverse circulation mud rotary" involves circulating mud down the annular space of the wellbore and back up through the drill pipe. This technique is not specifically discussed in this SOP.

3.1.3 A variety of different drill bits are available for mud rotary drilling. The type of bit used for a particular borehole depends upon the type of subsurface formation encountered. Button or cone type drilling bits are typically used to drill through granular soils, including coarse gravels. Bladed "drag" or "fishtail" type bits are commonly used to penetrate through clayey and silty soils. Some consolidated gravels and hard bedrock may require diamond bits or be too dense for adequate penetration rates.

3.1.4 Advantages: Mud rotary drilling advantages include rapid penetration of most hard soils, hardpans and gravelly soils, and penetration to depths in excess of 100 feet. Mud rotary drilling may be the technique of choice where depth requirements are beyond the range of auger drilling, drive casing methods are not feasible, or mud is required to maintain hole stability. Mud rotary methods are generally suitable for unconsolidated and consolidated soils and casing is usually not required for borehole stability. The open fluid-filled wellbore is ideal for borehole geophysical logging. Soil sampling is reliable and continuous core can be taken in most subsurface geologic units.

3.1.5 Disadvantages: Mud rotary drilling disadvantages are related to the use of drilling mud as a circulating medium. Drilling mud is usually a suspension of bentonite, water and additives requiring regular monitoring to maintain fluid weight, density, and viscosity. The mud invades pore spaces and mixes with formation fluids in the process of drilling, thereby causing "formation damage" and reducing well yield. Mud invasion makes identification of the water table and water bearing zones particularity difficult during drilling. Drilling muds can degrade groundwater and may provide a pathway for contamination across aquifers. Very loose soils may cave during drilling and continual mud circulation may cause excessive wellbore enlargement or "washouts". Bentonite complicates chemical analyses, particularity for metals, and may clog the sand packs in monitoring wells. Drilling fluids must be contained during drilling and require analysis after completion to determine disposal methods.

3.1.6 Additional Considerations: Soil cuttings are disaggregated by drilling making bedding and fabric determination difficult at best. The cuttings are typically saturated or coated with mud, requiring washing with water in a screen or sieve. See SOP 15.1 for additional remarks related to lithologic logging of soil cuttings.

3.1.7 Soil samples can be obtained from the bottom of the hole but sampling typically requires removing the entire drill string and sending the sampler through drilling mud. Mud rotary methods are not recommended when significant soil sampling or sampling for analytical parameters are required. This method can be used to install monitoring and pumping (extraction) wells. However, wells installed by this method require extensive development and may still have relatively low specific capacities due to formation damage.

4.0 PROCEDURE

This section contains responsibilities, requirements, and procedures for mud rotary drilling. The selection and implementation of mud rotary drilling techniques must incorporate site-specific conditions and requirements. Consequently, project work plans will identify the following:

- The purpose of each borehole (e.g., monitoring well installation, geophysical logging, coring or soil sampling, etc.);
- Specific methodology for drilling, including equipment, mud type(s), and cuttings/fluid containment;
- Specific locations, depths, and diameters of boreholes;
- Type of sampling and/or logging of borehole;
- Details of mobilization/demobilization and decontamination of equipment;
- Appropriate health and safety guidelines and personal protective equipment; and,
- Additional mud rotary drilling requirements or procedures beyond those covered in this SOP.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all mud rotary drilling is conducted and documented in accordance with this and any other appropriate procedures. This will be accomplished by staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project Quality Assurance Specialist (PQAS) is responsible for periodic review of field activities and the resulting documentation generated from this SOP. The PQAS is also responsible for the implementation of corrective action (retraining personnel, additional review of work plans and SOPs, variances to mud rotary drilling supervision requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to supervise mud rotary drilling are responsible for completing their tasks according to this and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 Equipment Requirements and Considerations

4.2.1 Rigs used for mud rotary drilling shall be of sufficient horsepower, torque and hoisting capacity to drill boreholes of anticipated diameter to anticipated maximum depths, as specified in the project work plans.

4.2.2 Drill rigs should preferably be self propelled or capable of accessing anticipated site field conditions.

4.2.3 Mud pits should be of sufficient volume to allow for adequate circulation of the drilling fluids. Portable mud pits with a "U" shaped arrangement or comprised of two separate tanks are preferred.

4.2.4 The drilling fluid conveyance system from the mud pits to the drill pipe should be entirely enclosed and fluid tight to minimize exposure of the drill crew to contaminated drilling mud.

4.2.5 Return drilling mud should be conveyed from the borehole to a shaker by a method that is fluid tight and does not allow cuttings to settle along the way. This shall be an entirely enclosed hose or pipeline.

4.2.6 The shaker is to be constructed and set up at each drilling site such that a field representative can easily reach across the top of the shaker screen to collect cuttings samples. The shaker screen should be of the correct type and mesh. Window screen is not acceptable.

4.2.7 Only preapproved additives may be used in the drilling mud. The additives must also meet regulatory requirements specific to the site and described in the project work plans.

4.2.8 Only Teflon™ based thread compound may be used to lubricate drill pipe threads. No other compound may be used.

4.2.9 Drill bit bearings and teeth should be in first class operating condition. Proper types of bits, slips, collars and subs are to be available at sizes needed to drill the desired diameters in the formation to be encountered.

4.3 Rig Decontamination and Preparation

4.3.1 All drilling and sampling equipment should be decontaminated before drilling as per SOPs 6.1 and 6.2, and the project work plans.

4.3.2 The driller and the rig geologist/engineer should inspect the drilling equipment for proper maintenance and appropriate decontamination. All clutches, brakes, rotary tables, swivels, kellys and drive heads should be in proper working order. All cables, hydraulic hoses, mud pumps and shakers should be in good condition. All pipe joints and bits should be in good condition with no worn threads, cracked tool joint connections or excessive wear etc.

4.3.3 Any excessive leakage of fluids from the rig or fluid circulation system (e.g., portable mud pits, mud pumps, hoses, etc.) should be immediately repaired and the rig or circulation equipment decontaminated again before it is allowed to mobilize to the site.

4.4 Site Preparation

4.4.1 The logistics of drilling, logging, sampling, cuttings/fluid containment, and/or well construction should be determined before mobilizing. The site should be prepared as per project work plans.

4.4.2 Before mobilization, the Site Superintendent and/or the rig geologist/engineer should assess the drilling site. This assessment should identify potential hazards (slip/trip/fall, overhead, etc.), and determine how drilling operations may impact the environment (dust, debris, noise). Potential hazards should be evaluated and corrected, or the borehole location changed or shifted as per the project work plans.

4.4.3 The Site Superintendent or appropriate designee should ensure that all identifiable underground utilities around the drilling location have been marked and the borehole location cleared as per project work plans. At a minimum, copies of the site clearance documents should be kept on-site in a common accessible location.

4.5 Mobilization and Set-up

4.5.1 Once site preparation is completed, the rig is mobilized to the site and positioned over the identified borehole location. The rig is then leveled with a set of hydraulic pads at the front and rear of the equipment. Once the rig is leveled, the mast should be raised slowly and carefully to prevent tipping or damaging the rig and to avoid hitting any obstructions or hazards.

4.5.2 Appropriate barriers and markers should be in place prior to drilling, as per the site health and safety plan. Visqueen (plastic) may be required beneath the rig and mud circulation system.

4.5.3 Appropriate fluids, cuttings, and other investigation-derived waste containment should be set up on site prior to the commencement of drilling.

4.6 Health and Safety Requirements

4.6.1 Tailgate Safety Meetings should be held in the manner and frequency stated in the health and safety plan. All Contractor and subcontractor personnel at the site should have appropriate training and qualifications as per the health and safety plan. Documentation should be kept readily available in the project files on site.

4.6.2 During drilling, all personnel within the exclusion zone should pay close attention to all rig operations. Rapidly rotating drill tools can catch or snag loose clothing causing serious injury.

4.6.3 Establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process.

4.6.4 The entire crew should be made aware to inform the site supervisor of any unforeseen hazard, or when anyone is approaching the exclusion zone.

4.7 Drilling Procedures

4.7.1 Breaking Ground and Surface Hole Drilling

4.7.2 Prior to the commencement of drilling, all safety sampling and monitoring equipment will be appropriately calibrated as per the project work plans. The rig geologist/engineer should inform the driller of the appropriate equipment (cookie cutter etc.) to be used for penetrating the specific surface cover (asphalt, concrete cement etc.) at the drilling location.

4.7.3 The upper or "surface hole" portion (first 5-20 feet below ground surface) of a mud rotary borehole is commonly drilled with the auger or air rotary drilling method in order to set a temporary conductor casing. The conductor casing is used to keep the upper portion of the hole open and to prevent drilling mud from channeling to the surface through shallow unconsolidated soils. The length of the conductor casing depends in part on the consolidation and permeability of the shallow subsurface soils. If geophysical logging is planned, the conductor pipe should only be as long as is necessary to keep the upper part of the hole open.

4.7.4 In the event of breaking ground where a shallow subsurface hazard may exist (unidentifiable utility, trapped vapors, etc.), the driller should be informed of the potential hazard. Drilling of the surface hole should commence slowly to allow continuous visual inspection and, if necessary, any interruptions for probing until the anticipated maximum depth of any suspected obstructions is exceeded.

4.7.5 Once the surface hole is drilled to the necessary depth, the conductor casing is then set in the borehole and the mud rotary drilling equipment is then set up for further drilling. Before commencement of mud rotary drilling, the drilling fluid or mud should be "made up" in the mud pits. The drilling mud properties (as specified in the project work plans) should then be verified to the satisfaction of the rig geologist/engineer before allowing drilling to proceed. These observations should also be documented by the rig geologist/engineer on the Field Activity Daily Log (FADL) (SOP 1.1).

4.8 Mud Rotary Borehole Drilling

4.8.1 During mud rotary drilling operations, as the borehole is advanced beyond the conductor casing, the rig geologist/engineer will generally:

- Observe and monitor rig operations;
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance;
- Prepare a lithologic log from cuttings, core or soil samples;
- Document drilling progress and other appropriate observations on the FADL (Attachment 6.1);
- Supervise the collection and preparation of any soil, soil vapor or groundwater samples; and,
- Supervise any borehole geophysical logging conducted in the wellbore.

4.8.2 As drilling progresses, the rig geologist/engineer should observe and be in frequent communication with the driller regarding drilling operations. Conditions noted should include relative rates of penetration (as indicated by fast or slow drilling), rotation speeds, chattering and bucking of the rig, lost returns, lost circulation zones, hard or sticky drilling, drilling refusal, etc.. These conditions, including penetration rates, should be recorded on the boring log as per SOP 15.1. Drilling should not be allowed to progress faster than the rig geologist/engineer can adequately observe conditions, compile cuttings logs and supervise safety and sampling activities.

4.8.3 The rig geologist/engineer should also observe the make-up and tightening of connections as additional pipe joints are added to the drill string. Any observed problems and causes, including significant down time, should be recorded on the FADL (SOP 1.1).

4.8.4 Cutting and fluid containment during drilling should be observed and supervised by the rig geologist/engineer as per specifications in the project work plans. The mud circulation system should be inspected periodically for leaks.

4.8.5 The rig geologist/engineer will continue to oversee or conduct appropriate health and safety sampling and monitoring during drilling. If any potentially unsafe conditions are evident from drilling observations or health and safety monitoring, the rig geologist/engineer may suspend drilling operations at any time and take appropriate actions as per the health and safety plan. In the event of a suspension of drilling activities:

- The Field Coordinator or Project Task Leader must be informed of the situation;
- Appropriate corrective action must be implemented before drilling may continue; and,
- The observed problem, suspension and corrective action must be entered on the FADL (SOP 1.1).

4.8.6 During drilling the rig geologist/engineer will compile a boring log as per SOP 15.1. The boring log should include:

- The borehole location with survey and map reference points;
- The name of the drilling company and drilling team;
- The dates and times of drilling events including when drilling began, the total depth and when it was reached, intermediate milestones (additional casing, geophysical logs etc.) and any changes in equipment (bits, drill pipe, tools etc.);
- weight, viscosity, yield point and additives;
- Relative drilling rate and presence of drill chatter. These parameters may confirm lithologic boundaries;
- Lithologic data from cuttings, core or soil samples including depths, frequency and quality;
- Intermediate sampling points for core or soil samples;

- Premature total depth due to refusal and the cause of refusal; and,
- Any other observed drilling conditions.

4.8.7 The rig geologist/engineer will also enter pertinent drilling information on the FADL (SOP 1.1). This includes but is not limited to the following:

- The dates and times of drilling events including when drilling began, the total depth and when it was reached, intermediate milestones (additional casing, geophysical logs etc.) and any changes in equipment (bits, drill pipe, tools etc.);
- The dates, times and causes of any significant down time; and,
- Premature total depth due to refusal and the cause of refusal.

4.8.8 Subsurface soil sampling with a drive sampler can be done at discrete intervals while drilling with mud rotary methods. However, driven samples typically require the removal of the drill pipe to advance the sampler beyond the bit. Depending on the drilled depth and the number of intervals to sample, this may not be efficient. Because the sampler passes through a mud medium, this method is not recommended for sampling soil for analytical parameters. Drive sampling conducted during mud rotary drilling should follow requirements in SOP 3.2. Representative soil vapor and groundwater (grab) samples are also generally not obtained during mud rotary drilling.

4.8.9 Borehole geophysical logs may be run at various depths or prior to completing the well. The rig geologist/engineer should note the type(s) of logs run, logging conditions, distribution of log copies and originals, and any observed problems on the FADL (SOP 1.1).

4.9 Borehole Abandonment

If the borehole is to be abandoned once drilling is completed, the abandonment should follow procedures outlined in SOP 8.3. The abandonment will be supervised by the rig geologist/engineer.

4.10 Monitoring Well Completion

Mud rotary boreholes can be used for monitoring well installation. However, installation of a monitoring well through drilling mud is difficult and may compromise the integrity of the well. A mud rotary drilled well will also require significantly more time for development. If a monitoring well is to be installed in the borehole, the procedures outlined in SOP 8.1 should be followed. The well installation will be supervised by the rig geologist/engineer.

4.11 Demobilization/Site Restoration

4.11.1 After drilling, sampling, and well installation or borehole abandonment is completed, the drill pipe and tools are laid down, the mast is lowered and the rig is moved off of the location. Demobilization/site restoration will be supervised by the rig geologist/engineer or appropriate designee.

4.11.2 All debris generated by the drilling operation should be appropriately disposed of.

4.11.3 The site should be cleaned, the ground washed as necessary, and the site conditions restored as per the project work plans.

4.11.4 All abandoned borings should be topped off and completed as per the project work plans. All monitoring wells should also have their surface completions finished as per the project work plans.

4.11.5 Any hazards remaining as a result of drilling activities should be identified and appropriate barriers and markers are put in place, as per the site health and safety plan.

4.11.6 All soil cuttings and fluids should be properly contained, clearly labeled and maintained in compliance with the project work plans.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be maintained in the Project Records file in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

AIR ROTARY DRILLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use during the drilling operations involving air rotary and air rotary casing hammer techniques. Additional specific drilling procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *SOP 3.2 - Subsurface Soil Sampling While Drilling*

2.2 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.3 *SOP 6.2 - Drilling and Heavy Equipment Decontamination*

2.4 *SOP 8.1 - Monitoring Well Installation*

2.5 *SOP 8.3 - Borehole and Well Abandonment*

2.6 *SOP 10.1 - Soil Organic Vapor Sampling*

2.7 *SOP 10.2 - Cone Penetration Testing and HydroPunch Ground water Sampling*

2.8 *SOP 15.1 - Lithologic Logging*

2.9 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Air Rotary Drilling

3.1.1 Any method of drilling that employs a rotating drill pipe and bit to advance the borehole and uses air as a circulating medium. Air is forced down through the center of the drill pipe, out through the bit at the bottom of the borehole, and then upward in the annular space between the borehole wall and drill pipe. The upward return stream removes cuttings from the bottom of the borehole.

3.1.2 Air rotary drilling is commonly limited in environmental projects to drilling in hard consolidated rock for coring and installing wells. It may at times be used to drill consolidated sediment or soil. Air rotary drilling achieves some of the fastest penetration rates, compared to other drilling methods, in hard rock terrain.

3.1.3 Air rotary drilling commonly has problems in drilling unconsolidated coarse sediment or soil. The air does not provide sufficient density or viscosity to keep the borehole open while drilling through these deposits and the borehole collapses, binding the bit in the hole. In addition the air circulation is lost through invasion into coarse permeable beds.

3.1.4 Foam additives have been developed to combat these problems but are not allowed by regulatory agencies for use on environmental projects. The air rotary casing hammer drilling method was developed to surmount these problems and is covered below.

3.1.5 A variety of drilling bits may be used to penetrate various formations encountered. Cone type bits and down-hole hammers with button bits are typically used to drill through consolidated rock and granular soils. Drag (fishtail) type bits are commonly used to progress through clayey and silty soils.

3.1.6 Cuttings produced by this method are typically disaggregated making bedding and fabric determination difficult at best. Soil samples can be obtained from the bottom of the hole; however, it typically requires removing the entire drill string.

3.1.7 Additional considerations in using air rotary drilling techniques include the potential of pushing vapor phase contaminants into the surrounding soil/rock matrix and flushing samples, and the possibility of vapors exiting the borehole.

3.2 Air Rotary Casing Hammer Drilling

3.2.1 This drilling method is similar to the air rotary method in that it uses an air rotary drill string (drill pipe and bit) contained inside a slightly larger diameter drive casing. The drive casing is a heavy-walled, threaded pipe that allows for pass-through of the rotary drill bit inside the center of the casing. The drive casing is used to maintain borehole stability, temporarily isolate multiple contaminated zones, and reduce lost circulation of the subsurface air stream.

3.2.2 During drilling the hole is deepened with the air rotary drill string. The drive casing is advanced simultaneously with the air rotary bit, using a rig-mounted hydraulic or air hammer. The drive casing is not rotated.

3.2.3 Air is forced down through the center drill pipe to the bit, and then upward through the space between the drive casing and the drill pipe. The upward return stream removes cuttings from the bottom of the borehole.

3.2.4 This method is highly useful in drilling coarse unconsolidated sediment and soils. Consequently, it is used far more commonly in environmental projects than the air rotary method above. The method is also commonly used to install monitoring wells as there is good depth control, and the drive casing can be progressively pulled as well construction materials are placed in the borehole.

3.2.5 The air rotary casing hammer method is also used to drill through consolidated rock and large boulder beds. For these types of formations a eccentric underreaming bit assembly (such as the ODEX™ or STRATEX™ systems) is attached to the inner rotary drill string. The eccentric underreamer drills a slightly larger diameter borehole than the drive casing. This allows the casing to be advanced while drilling through boulders and bedrock.

3.2.6 Cuttings produced by this method are typically disaggregated, like the air rotary method above. Soil samples can be obtained from the bottom of the hole; however, it typically requires removing the entire inner rotary drill string for each sample run.

4.0 PROCEDURE

4.1.1 This section contains responsibilities, requirements, and procedures for air rotary casing hammer drilling. As stated above, the air rotary casing hammer method more commonly used for environmental projects than just air rotary alone. Consequently, air rotary casing hammer drilling is covered in the remainder of this document. The procedures and requirements for air rotary drilling would essentially be similar to those outlined for the air rotary casing hammer technique.

4.1.2 The selection and implementation of air rotary casing hammer drilling techniques must incorporate site specific conditions and requirements. Consequently, the project work plans will identify the following:

- The purpose of each borehole (e.g., to install monitoring well, soil sampling, soil vapor sampling, etc.).

4.1.3 Specific methodology for drilling, including equipment to be utilized and cuttings/fluid containment requirements

- Specific locations, depths, and diameters of boreholes;
- Type of sampling and/or logging of borehole;
- Details of mobilization/demobilization and decontamination of equipment;
- Appropriate health and safety guidelines and personnel protective equipment requirements; and,
- Additional procedures or requirements beyond those covered in this SOP.

4.2 Responsibilities

4.2.1 The Field Coordinator is responsible for ensuring that all air rotary casing hammer drilling activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.2.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retaining personnel, additional review of work plans and SOPs, variances to air rotary casing hammer drilling requirements, issuing nonconformances, etc.) if problems occur.

4.2.3 Field personnel assigned to air rotary casing hammer drilling activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.3 Equipment Requirements and Considerations

4.3.1 Rigs used for air rotary casing hammer drilling shall have the hammer handling system integrally built into the mast assembly. The use of retrofitted drilling rigs without a swing-out, independently operated drive hammer will not be allowed. A rig which requires personnel to climb onto the mast to attach or detach the hammer is unacceptable for safety reasons.

4.3.2 The drill rigs should preferably be self-propelled and capable of accessing anticipated site field conditions. Each rig should have a mechanical draw-works capable of holding roughly 30,000 lbs (minimum) and be equipped with a water injection pump.

4.3.3 The casing hammer shall be a drill-through, pneumatic type with a minimum rated energy force of 7,200 ft. lbs. The casing hammer will have a rotary drilling rod packing assembly to pressurize the system for an air tight seal, ensuring that all cuttings, water and air are discharged through the hammer exit spout.

4.3.4 The hammer spout will have attached a removable discharge hose of sufficient size and length to reach the cyclone when the hammer is raised to the top of the mast. The hose shall be properly anchored and attached to a cyclone that effectively decelerates cuttings from the air stream.

4.3.5 An air compressor or combination of compressors will be made available and meet minimum discharge requirements at specified pressures. An example discharge/pressure combination for 300 foot borings through interbedded cobble and silt strata is 750 cfm at 250 psi. In-line 0.3 micron filters will be installed in the air stream from the compressor(s) for reducing oil content. The filters will be inspected and changed on a regular basis to prevent the passage of oil into the subsurface.

4.3.6 Drive casings should have a minimum tensile strength of 100,000 psi, and will have external and internal flush threads on each pin and box for connecting. The use of rope thread drive casing with dissimilar metal threaded end pieces attached to mild steel casing bodies will not be allowed. The drive casing shall have uniform wall thickness, tensile strength, and threaded ends machined directly to the casing. A hardened drive shoe with the same internal and external dimensions of the drive casing will be threaded to the bottom of the first joint of the drive casing.

4.3.7 Only Teflon™ based thread compound may be used to lubricate drill pipe and drive casing threads. No other thread compound may be used.

4.3.8 Drive casings of various lengths should be provided by the subcontractor to facilitate emplacement of sand pack, bentonite seal, and grout. One 3-foot, two 5-foot and two 10-foot lengths, besides a sufficient number of standard length drive casing joints, are recommended for each rig.

4.3.9 A hydraulic casing extractor must be used to remove the drive casing from the borehole. Extraction of the casing by "hammering-up" with the casing hammer will not be allowed. The hydraulic casing extractor should have a minimum pulling capacity of 250 tons and be constructed as a single unit with hydraulic cylinders, pulling arms, base plate, valves, hoses, slips and spiders, safety bypass valves, back-up wrench, and break-out tongs. The slips and spiders should be of sufficient size to grip the outside of the drive casing and withstand the lifting force of 250 tons.

4.4 Rig Decontamination and Preparation

4.4.1 All drilling and sampling equipment should be decontaminated before drilling as per SOP 6.1 and 6.2 and the project work plans.

4.4.2 The driller and rig geologist/engineer should inspect the drilling equipment for proper maintenance and appropriate decontamination prior to each time the rig is mobilized to a site. All clutches, brakes and drive heads should be in proper working order. All cables and hoses should be in good condition. All drill pipe, drive casing and bits should also be in good condition (e.g., no damaged threads on the drive casing or drill pipe, no damaged or excessively worn bits, etc.).

4.4.3 Any observed leakage of fluids from the rig should be immediately repaired and the rig decontaminated again before it is allowed to mobilize.

4.5 Site Preparation

4.5.1 The logistics of drilling, logging, sampling, cuttings/fluid containment, and/or well construction should be determined before mobilizing. The site should be prepared as per the project work plans.

4.5.2 Before mobilization, the Field Coordinator and/or the rig geologist/engineer should assess the drilling site with the driller. Drill site space requirements commonly include not only area for the rig, but also swing-out clearance for the cyclone and access for a pipe truck or fork lift carrying pipe. This assessment should identify potential hazards (slip/trip/fall, overhead power lines, etc.), and determine how drilling operations may impact the environment (dust, debris, noise). Potential hazards should be evaluated and corrected, or the borehole location changed or shifted, as per the project work plans.

4.5.3 The Field Coordinator or appropriate designee should ensure that all identifiable underground utilities around the drilling location have been marked, and the borehole location appropriately cleared per the project work plans. At a minimum, copies of the site clearance documents should be kept on-site.

4.6 Mobilization and Set-Up

4.6.1 Once the site is prepared, the rig is mobilized to the site and located over the borehole location. The rig is leveled with a set of hydraulic pads attached to the front and rear of the rig. The driller should always raise the mast slowly and carefully to prevent tipping or damaging the rig, and avoiding obstructions or hazards. The cyclone should be positioned so that cuttings can be easily collected as they drop out of the bottom opening.

4.6.2 Appropriate barriers and markers should be in place prior to drilling, as per the site health and safety plan. Visqueen (plastic) may be required beneath the rig per the project work plans.

4.6.3 Appropriate cuttings and other investigation-derived waste containment should be set on site prior to commencement of drilling. If drilling is to be conducted in the saturated zone, provisions should be made to ensure adequate containment of formation water produced during drilling operations.

4.7 Health and Safety Requirements

4.7.1 Tailgate Safety Meetings should be held in the manner and frequency stated in the health and safety plan. All Contractor and subcontractor personnel at the site should have appropriate training and qualifications as per the health and safety plan.

4.7.2 During drilling all personnel within the exclusion zone should pay close attention to rig operations. The drill pipe and drive casing are quite heavy, and dangerous if dropped. Other equipment on the rig can easily snag clothing and crush fingers or limbs. In addition, heavy equipment such as pipe trucks and fork lifts may be operated at the drill site.

4.7.3 The casing hammer is quite noisy when the drive casing is being advanced. In addition, the rig can generate considerable noise when drilling through gravel and cobbles. Therefore, establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The entire crew should be made aware to inform the rig geologist/engineer of any unforeseen hazard, or when anyone is approaching the exclusion zone.

4.8 Breaking Ground

4.8.1 Prior to the commencement of drilling, all safety sampling and monitoring equipment will be appropriately calibrated per the project work plans.

4.8.2 The rig geologist/engineer should inform the driller of the appropriate equipment (e.g., cookie cutter, etc.) to be used for penetration of the surface cover (e.g., asphalt, concrete, cement, etc.). In the event of breaking ground where a shallow subsurface hazard may exist (unidentifiable utility, trapped vapors, etc.), the driller should be informed of the potential hazard. Drilling should commence slowly to allow continuous visual inspection and/or monitoring, and if necessary, stop for probing or hand excavation and clearance.

4.9 Borehole Drilling

4.9.1 During drilling operations, and as the borehole is advanced, the rig geologist/engineer will generally:

- Observe and monitor rig operations;
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance;
- Prepare a lithologic log from soil samples or cuttings; and,
- Supervise the collection of, and prepare soil, soil vapor, and ground water samples.

4.9.2 As drilling progresses the rig geologist/engineer will be in frequent communication with the driller and be cognizant of drilling conditions which may provide lithologic or chemical information. This includes relative rates of penetration (indicative of fast or slow drilling) and chattering or bucking of the rig. These conditions should be recorded on the boring log per SOP No, 15.1.

4.9.3 The rig geologist/engineer should know the total depth of the borehole at all times during drilling. Drilling should not be allowed to progress faster than the rig geologist/engineer can adequately observe conditions, compile boring logs, and supervise sampling and safety activities.

4.9.4 The rig geologist/engineer should also observe the rig operations, including the make-up and tightening of connections as additional drill pipe and drive casing are added to the drill string. No leaks should be evident in the air system on the rig. This includes the drill pipe extending from the top head drive through the casing hammer. Any observed problems, including significant down time, and their causes are recorded on the Field Activity Daily Log (FADL) (SOP 1.1).

4.9.5 Cuttings and fluids containment during drilling should be observed and supervised by the rig geologist/engineer, as per specifications in the project work plans.

4.9.6 The rig geologist/engineer will oversee or conduct appropriate health and safety sampling and monitoring. If any potentially unsafe conditions are evident from the above drilling observations and the health and safety sampling and monitoring, the rig geologist/engineer may suspend drilling operations at any time and take appropriate actions as per the health and safety plan. In the event suspension of drilling activities occur:

- The Site Superintendent must be informed of the situation;
- Appropriate corrective action must be implemented before drilling may be continued; and,
- The observed problem, suspension, and corrective action are entered on the FADL.

4.9.7 In some instances water may need to be added to the air stream to circulate cuttings to the surface. This should be done only if absolutely necessary, following specifications for the water source and/or any sampling and analysis requirements per the project work plans. Foam additives should not be used and are commonly prohibited by regulatory agencies for environmental applications. If water is injected into the borehole it should be noted on the boring log and the FADL.

4.9.8 During drilling the rig geologist/engineer will compile a boring log as per SOP No. 15.1. The log will be compiled preferably from soil samples recovered while drilling. Logs should only be compiled solely from cuttings if this is the only available option. The cuttings are obtained by a fine mesh basket or other appropriate container held under the bottom opening of the cyclone.

4.9.9 Observations of drilling conditions and responses are also entered on the log as discussed above and in SOP No. 15.1. If total depth was reached prematurely due to refusal, the cause of refusal should be noted on the boring log and the FADL.

4.9.10 Subsurface soil samples may be collected with a split spoon sampler or Shelby tube during drilling per SOP No. 3.2. This will require tripping out (removing) the inner rotary drill string. The sampling will be supervised by the rig geologist/engineer. Soil samples (drive samples) can be readily obtained at discrete intervals with these methods.

4.9.11 Soil organic vapor (SOV) sampling may be conducted at discrete intervals during air rotary casing hammer drilling. This is done by stopping at the desired depth, tripping out the inner rotary drill string, and driving a sample probe through the drive casing into the soil ahead of the drive shoe. The vapor sample is then collected through the sample probe using a vacuum pump at the surface. The sampling should be supervised by the rig geologist/engineer following procedures in SOP No. 10.1.

4.9.12 Ground water screening (grab) samples can be obtained at discrete intervals during drilling. One method is to drill to the bottom of the selected interval or zone and pull the drive casing back a selected distance, allowing ground water through the open borehole. The inner rotary drill string is tripped out of the hole and a water sample is then collected with a bailer run through the inside of the drive casing.

4.9.13 Another method is to stop the drill string at a selected interval or zone, trip out the inner rotary drill string, and advance a hydropunch sampler beyond the drive casing to retrieve a water sample. The ground water screening sampling procedures should essentially follow those described in SOP 10.2.

4.10 Borehole Abandonment

If the borehole is to be abandoned once drilling is completed, the abandonment will follow procedures outlined in SOP 8.3. The abandonment will be supervised by the rig geologist/engineer.

4.11 Monitoring Well Completion

If a monitoring well is to be installed in the borehole, the well completion will follow procedures outlined in SOP 8.1. The well installation activities will be supervised by the rig geologist/engineer.

4.12 Demobilization/Site Restoration

4.12.1 After drilling, sampling, well installation, or borehole abandonment is completed the air rotary casing hammer rig is rigged down and removed from the borehole location. The demobilization/site restoration will be supervised by the rig geologist/engineer or appropriate designee.

4.12.2 All debris generated by the drilling operation will be appropriately disposed.

4.12.3 The site should be cleaned (ground washed if necessary) and surface conditions restored as per the project work plans.

4.12.4 All abandoned borings should be topped off and completed as per the project work plans. All monitoring wells will also have their surface completions finished as per the project work plans.

4.12.5 Any remaining hazards as a result of drilling activities will be identified and appropriate barriers and markers put in place, as per the health and safety plan.

4.12.6 All soil cuttings and fluids will be properly contained, clearly labeled, and maintained as per the project work plans.

4.12.7 The Field Coordinator or appropriate designee should inspect the site to make sure that post-drilling site conditions are in compliance with the project work plans.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be maintained in the Project Records file in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

DUAL TUBE PERCUSSION DRILLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for field personnel to use during the supervision of drilling operations involving dual tube percussion techniques. Additional specific dual tube percussion drilling procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *SOP 3.2 - Subsurface Soil Sampling While Drilling*

2.2 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.3 *SOP 6.2 - Drilling and Heavy Equipment Decontamination*

2.4 *SOP 8.1 - Monitoring Well Installation*

2.5 *SOP 8.3 - Borehole and Well Abandonment*

2.6 *SOP 10.1 - Soil Organic Vapor Sampling*

2.7 *SOP 10.2 - Cone Penetration Testing and HydroPunch Ground Water Sampling*

2.8 *SOP 15.1 - Lithologic Logging*

2.9 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

A drilling method using nonrotating drive casing with a bit on the bottom of the casing. A smaller diameter tube or drill pipe is positioned inside the drive casing and the drive casing is advanced by the use of a percussion hammer, thereby causing the bit to cut or break up the sediment or soil at the bottom of the boring. Air is forced down the annular space between the drive casing and inner drill pipe, and cuttings are forced up the center of the inner drill pipe.

3.1.1 Advantages: Dual tube percussion drilling advantages include rapid penetration rates, accurate water table location and representative subsurface sampling. This method is suitable for unconsolidated and consolidated soils but some consolidated gravels and hard bedrock may be too dense for adequate drill penetration. Unlike mud rotary, or air rotary methods, soil samples can be readily obtained from the bottom of the hole without removing the drill pipe. Loose or soft soil cuttings are disaggregated, but consolidated materials and gravel are often retrieved in sizable chunks, up to 6 inches in diameter, making bedding and fabric determination possible. See SOP No. 15.1 for additional remarks related to lithologic logging of soil cuttings. Dual tube percussion drilling is commonly used to install monitoring wells because depth control is good and the drive casing can be progressively pulled as well construction materials are added to the borehole.

3.1.2 Disadvantages: Dual tube percussion drilling disadvantages are related to the use of air in the process of drilling. Air compressors are generally noisy and may pose problems ranging from nuisance complaints in populated areas to health risks without adequate hearing protection in an exclusion zone. Air from the compressors contains oils and must be filtered. The casing hammer must be retrofitted to exclude diesel fuel venting and potential contamination of the work area toward the back of the rig. Rapid drilling requires a large container for cuttings. Large quantities of potentially contaminated formation water can also be produced and must be contained.

3.1.3 Additional Considerations: Additional considerations for using dual tube percussion methods include the potential of pushing vapor phase contaminants into the surrounding soil and the possibility of vapors exiting the hole. Dual tube percussion rigs are typically larger than auger-type rigs and may be subject to size constraints, including overhead clearance. The impact of the casing hammer is loud and sharp and may limit operations in populated areas.

4.0 PROCEDURE

This section contains responsibilities, requirements, and procedures for dual tube percussion drilling. The selection and implementation of dual tube percussion drilling techniques must incorporate site-specific conditions and requirements. Consequently, project work plans will identify the following as applicable:

- The purpose of each borehole (e.g., to install a monitoring well, soil sampling, ground water screening sampling, etc.);
- Specific methodology for drilling, including equipment and cuttings/fluid containment requirements;
- Specific locations, depths, and diameters of boreholes;
- Type of sampling and/or logging of the borehole;
- Details of mobilization/demobilization and decontamination of equipment; and,

- Appropriate health and safety guidelines and personal protective equipment requirements.

4.1 Responsibilities

4.1.1 The Field Coordinator is responsible for ensuring that all dual tube percussion drilling is conducted and documented in accordance with this and any other appropriate procedures. This will be accomplished by staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field activities and the resulting documentation generated as a result of implementing this SOP. The PQAS is also responsible for the implementation of corrective action (retraining personnel, additional review of work plans and SOPs, variances to dual tube percussion drilling supervision requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to supervise dual tube percussion drilling are responsible for completing their tasks according to this and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 Equipment Requirements and Considerations

4.2.1 Rigs used for dual tube percussion drilling shall have the hammer handling system integrally built into the mast assembly. The use of retrofitted drilling rigs without a swing-out, independently operated drive hammer will not be allowed. A rig which requires personnel to climb onto the mast to attach or detach the hammer is unacceptable for safety reasons.

4.2.2 The drill rigs should preferably be self-propelled and capable of accessing anticipated site field conditions. Each rig should have a mechanical draw-works capable of holding roughly 30,000 lbs. (minimum) and be equipped with a water injection pump.

4.2.3 The pile drive hammer should be a link belt diesel hammer with a minimum rated energy force of 8,200 ft-lbs. The dual tube system must be completely water and air tight from drill bit to cyclone, ensuring that all cuttings, water and air are discharged through a cyclone separator at a single location near the rig.

4.2.4 The hammer spout will have attached a removable discharge hose of sufficient size and length to reach the cyclone when the hammer is raised to the top of the mast. The hose shall be properly anchored and attached to a cyclone that effectively decelerates cuttings from the air stream.

4.2.5 An air compressor or combination of compressors will be made available and meet minimum discharge requirements at specified pressures. An example discharge/pressure combination for 200 foot borings through interbedded cobble and silt strata is 750 cfm at 250 psi. In-line 0.3 micron filters will be installed in the air stream from the compressor(s) for reducing oil content. The filters will be inspected and changed on a regular basis to prevent the passage of oil into the subsurface.

4.2.6 Drive casings should have a minimum tensile strength of 100,000 psi, and will have external and internal flush threads on each pin and box for connecting. The use of rope thread drive casing with dissimilar metal threaded end pieces attached to mild steel casing bodies will not be allowed. The drive casing shall have uniform wall thickness, tensile strength, and threaded ends machined directly to the casing. A hardened bit with the same external dimensions of the drive casing will be threaded to the bottom of the first joint of the drive casing.

4.2.7 Only Teflon™ based thread compound may be used to lubricate drill pipe and drive casing threads. No other thread compound may be used.

4.2.8 Drive casings of various lengths should be provided by the subcontractor to facilitate emplacement of sand pack, bentonite seal, and grout. One 3-foot, two 5-foot and two 10-foot lengths, besides a sufficient number of standard length drive casing joints, are recommended for each rig.

4.2.9 A hydraulic casing extractor must be used to remove the drive casing from the borehole. The hydraulic casing extractor should have a minimum pulling capacity of 250 tons and be constructed as a single unit with hydraulic cylinders, pulling arms, base plate, valves, hoses, slips and spiders, safety bypass valves, back-up wrench, and break-out tongs. The slips and spiders should be of sufficient size to grip the outside of the drive casing and withstand the lifting force of 250 tons.

4.3 Rig Decontamination and Preparation

4.3.1 All drilling and sampling equipment must be decontaminated before drilling as per SOPs 6.1 and 6.2, and the project work plans.

4.3.2 The driller and the rig geologist/engineer should inspect the drilling equipment for proper maintenance and appropriate decontamination. All clutches, brakes and drive heads should be in proper working order. All cables and hydraulic hoses should be in good condition. All tool joints and bits should be in good condition with no worn threads, cracked tool joint connections or excessive wear etc..

4.3.3 Any excessive leakage of fluids from the rig should be immediately repaired and the rig decontaminated again before it is allowed to mobilize to the site.

4.3.4 Filters for the air stream from the compressor should be inspected to ensure they are the right type and properly installed as per the project work plans.

4.4 Site Preparation

4.4.1 The logistics of drilling, logging, sampling, cuttings/fluid containment, and/or well construction should be determined before mobilizing. The site should be prepared as per the project work plans.

4.4.2 Before mobilization, the Field Coordinator and/or the rig geologist/engineer should assess the drilling site. This assessment should identify potential hazards (slip/trip/fall, overhead, etc.), and determine how drilling operations may impact the environment (dust, debris, noise). Potential hazards should be evaluated and corrected, or the borehole location changed or shifted as per the project work plans.

4.4.3 The Field Coordinator or appropriate designee should ensure that all identifiable underground utilities around the drilling site have been located and marked and the borehole location cleared as per project work plans.

4.5 Mobilization and Set-up

4.5.1 Once site preparation is completed, the rig is mobilized to the site and positioned over the identified borehole location. The rig is then leveled with a set of hydraulic pads at the front and rear of the equipment. Once the rig is leveled, the mast should be raised slowly and carefully to prevent tipping or damaging the rig and to avoid hitting any obstructions or hazards.

4.5.2 Appropriate barriers and markers should be in place prior to drilling, as per the site health and safety plan. Visqueen (plastic) may be required beneath the rig and fluid circulation system.

4.5.3 Appropriate cuttings and other investigation-derived waste containment should be set up on site prior to the commencement of drilling.

4.6 Health and Safety Requirements

4.6.1 Tailgate Safety Meetings must be held in the manner and frequency stated in the health and safety plan. All Contractor and subcontractor personnel at the site will have appropriate training and qualifications as per the health and safety plan. Documentation should be kept readily available in the project files on site.

4.6.2 During drilling, all personnel within the exclusion zone should pay close attention to all rig operations. The drillpipe and drive casing are heavy and can be dangerous if dropped. The drive hammer can easily crush fingers or limbs. Other equipment can snag loose clothing causing serious injury.

4.6.3 Establishing clear communication signals with the drilling crew is mandatory since verbal signals may not be heard during the drilling process. The air compressor and casing hammer generate considerable noise, especially when drilling through harder sediments. Hearing protection must be worn when working around the rig as per the health and safety plan.

4.6.4 The entire crew should be made aware to inform the rig geologist/engineer of any unforeseen hazard, or when anyone is approaching the exclusion zone.

4.7 Breaking Ground

4.7.1 Prior to the commencement of drilling, all safety sampling and monitoring equipment will be appropriately calibrated as per the project work plans.

4.7.2 The rig geologist/engineer should inform the driller of the appropriate equipment (cookie cutter etc.) to be used for the specific surface cover (asphalt, concrete cement etc.) present. In the event of breaking ground where a shallow subsurface hazard may exist (unidentifiable utility, trapped vapors, etc.), the driller should be informed of the potential hazard and drilling should commence slowly to allow continuous visual inspection and, if necessary, any interruptions for probing.

4.8 Borehole Drilling

4.8.1 During drilling operations, as the borehole is advanced, the rig geologist/engineer will generally:

- Observe and monitor rig operations;
- Conduct all health and safety monitoring and sampling, and supervise health and safety compliance;
- Prepare a lithologic log from soil samples or cuttings;
- Prepare a Field Daily Activity log (FADL); and,
- Supervise the collection and preparation of any soil, soil vapor, and ground water samples.

4.8.2 As drilling progresses, the rig geologist/engineer should observe and be in frequent communication with the driller regarding drilling operations. Conditions noted may include relative rates of penetration (as indicated by fast or slow drilling), lost returns or lost circulation zones, sticky drilling, first encountered water, relative yield of formation water, drilling refusal, etc. These conditions, including penetration rates, should be recorded on the boring log as per SOP 15.1. Drilling should not be allowed to progress faster than the rig geologist/engineer can adequately observe conditions, compile cuttings logs and supervise safety and sampling activities.

4.8.3 The rig geologist/engineer should also observe rig operations including the make-up and tightening of connections as additional joints are added to the drill string. Any observed problems and causes, including significant down time, should be recorded on the Field Activity Daily Log (FADL) (SOP 1.1).

4.8.4 Cutting and fluid containment during drilling should be observed and supervised by the rig geologist/engineer as per specifications in the project work plans. If significant amounts of moist, fine-grained materials are encountered, the driller may need to add water to the air stream to prevent clogging. This addition of water should also be noted on the boring log.

4.8.5 The rig geologist/engineer will oversee or conduct appropriate health and safety sampling and monitoring. If any potentially unsafe conditions are evident from drilling observations or health and safety monitoring, the rig geologist/engineer may suspend drilling operations at any time and take appropriate actions as per the Health and safety plan. In the event of a suspension of drilling activities:

- The Field Coordinator or Project Task Leader must be informed of the situation;
- Appropriate corrective action must be implemented before drilling may continue; and,
- The observed problem, suspension and corrective action must be entered on the FADL.

4.8.6 During drilling the rig geologist/engineer will compile a boring log as per SOP 15.1. The boring log should include:

- The borehole location with survey and map reference points;
- The name of the drilling company and drilling team;
- The dates and times of drilling events including when drilling began, the total depth of the boring and when it was reached, intermediate milestones (additional casing, sampling points etc.) and any changes in equipment (bits, drillpipe, tools etc.);
- Relative drilling conditions as noted in Section 4.4.2.1 above. These parameters may confirm lithologic boundaries and other important subsurface conditions;
- Lithologic data from cuttings, core or soil samples including depths, frequency and quality;
- Intermediate sampling points for core or soil samples;
- Depths, frequency and relative quality of soil vapor, and ground water samples; and,
- Premature total depth due to refusal and the cause of refusal.

4.8.7 The rig geologist/engineer will also prepare a Field Daily Activity Log (FADL) (SOP 1.1) that should include:

- The dates and times of drilling events including when drilling began, the total depth of the boring and when it was reached, intermediate milestones (additional casing, sampling points etc.) and any changes in equipment (bits, drillpipe, tools etc.);
- The dates, times and causes of any significant down time; and,
- Premature total depth due to refusal and the cause of refusal.

4.8.8 Subsurface soil samples may be collected with a split spoon sampler during drilling per SOP 3.2. This is commonly accomplished with the sampler attached to a set of jars. The jars/sampler assembly is suspended on a wireline from the rig and run inside the inner drill pipe to the bottom of the boring. The sampler is then driven into the soil ahead of the bit with the jars. Once sufficient penetration into the soil is achieved, the sampler is retrieved with the wireline. The sampling will be supervised by the rig geologist/engineer.

4.8.9 Soil organic vapor (SOV) sampling may be conducted at discrete intervals during dual tube percussion drilling. This is done by stopping at the desired depth and running a sample probe through the inner drill pipe to the bottom of the boring. The probe is then driven past the bit into the underlying soil. The vapor sample is then collected through the sample probe using a vacuum pump at the surface. The sampling should be supervised by the rig geologist/engineer following procedures in SOP 10.1.

4.8.10 Ground water screening (grab) samples can be obtained at discrete intervals during drilling. One method is to drill to the bottom of the selected interval or zone and pull the drive casing back a selected distance, allowing ground water through the open borehole. A water sample is then collected with a bailer run through the inside of the inner drill pipe.

4.8.11 Another method is to stop the drill string at a selected interval or zone. A hydropunch sampler is then run inside the inner drill pipe and beyond the drive casing (into the underlying soil) to retrieve a water sample. The ground water screening sampling procedures should essentially follow those described in SOP 10.2.

4.9 Borehole Abandonment

If the borehole is to be abandoned once drilling is completed, the abandonment will follow procedures outlined in SOP 8.3. The abandonment will be supervised by the rig geologist/engineer.

4.10 Monitoring Well Completion

If a monitoring well is to be installed in the borehole, the well completion will follow procedures outlined in SOP 8.1. The well installation activities will be supervised by the rig geologist/engineer.

4.11 Demobilization/Site Restoration

4.11.1 After drilling, sampling, well installation or borehole abandonment the drilling tools are laid down, the mast is lowered and the rig is moved off of the location. Demobilization/site restoration will be supervised by the rig geologist/engineer or appropriate designee.

4.11.2 All debris generated by the drilling operation should be appropriately disposed.

4.11.3 The site is cleaned, the ground is washed if necessary and the site conditions restored as per project work plans.

4.11.4 All abandoned borings are topped off and completed as per the project work plans. All monitoring wells will also have their surface completions finished as per the project work plans.

4.11.5 Any hazards remaining as a result of drilling activities are identified and appropriate barriers and markers are put in place, as per the site health and safety plan.

4.11.6 All soil cuttings and fluids are properly contained and clearly labeled and maintained in compliance with the project work plans.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be maintained in the Project Records file in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

LITHOLOGIC LOGGING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes the basic methods for logging soil using the USCS visual method. Use of visual examination and simple manual tests associated with the USCS procedure gives standardized criteria and processes for describing and identifying soils. Logging soil assures that data, information, and descriptions generated from each borehole or excavation are properly collected and documented. Furthermore, proper documentation and logging of soil allows direct comparison of lithology between different boreholes. This document describes:

- the methods for describing soil samples;
- what information is necessary to complete the lithologic log;
- the required forms on which field observations are logged; and,
- the equipment necessary for logging and visual classification of soil samples.

2.0 REFERENCES

2.1 *U.S. Department of the Interior, Bureau of Reclamation (USBR), 1986, Procedures for Determining Unified Soil Classification (Visual Method), USBR 5005-86*

2.2 *SOP 2.1 - Sample Handling, Packaging, and Shipping (Appendix A)*

3.0 DEFINITIONS

This section presents definitions of some of the common basic terminology utilized in soil classification. These definitions do not substitute for the training and experience required in learning the multitude of definitions used in soil classification.

3.1 Gravel

Particles of rock that will pass a 3-inch sieve and be retained on a No. 4 sieve. Criteria to distinguish coarse and fine is provided in Section 5.2.1 of Reference 2.1.

3.2 Sand

Particles of rock that will pass a No. 4 sieve and be retained on a No. 200 sieve. Criteria to distinguish coarse, medium, and fine is provided in Section 5.2.2 of Reference 2.1.

3.3 Clay

Soil passing the No. 200 sieves that exhibits plasticity (putty-like properties) within a range of moisture contents, and which exhibits considerable dry strength when air-dry. Criteria to distinguish inorganic and organic clay are provided in Section 5.2.5 and 13.6 through 13.7.2 of Reference 2.1.

3.4 Silt

Material passing the No. 200 sieve that is non-plastic or very slightly plastic and exhibits little or no strength when air-dry. Criteria to distinguish inorganic and organic silt are provided in Sections 5.2.6, 13.7.3, and 13.7.4 of Reference 2.1.

3.5 Dry Strength

This is the resistance of a 1/4-inch air-dry ball made from the test material to crushing between the fingers. Dry strength is described with the terms None, Low, Medium, High, and Very High. Dry strength testing procedures are presented in Sections 13.2 of Reference 2.1.

3.6 Penetration Resistance

Penetration resistance is based on blow counts recorded per foot while driving a Standard Penetration Sampler with a 140-pound hammer. A larger diameter sampler will have higher blow counts.

3.7 Dilatancy

This is a measure of the ability of a 1/2- to 1-inch-long pat made from the test material to yield water when shaken horizontally. Dilatancy is described with the terms None, Slow, and Rapid. Dilatancy testing procedures are presented in Section 13.3 of Reference 2.1.

3.8 Toughness

This is a measure of the test material's ability to be rolled into a 1/8-inch-diameter thread. Toughness is described with the terms Low, Medium, and High. Toughness testing procedures are presented in Section 13.4 of Reference 2.1.

3.9 Plasticity

This is a description of the test sample behavior derived during the performance of the toughness test. Plasticity is described with the terms Nonplastic, Low, Medium, and High. Plasticity testing procedures are presented in Section 13.5 of Reference 2.1.

3.10 Color

3.6.1 There are two approaches to identifying the color of samples. Either the Rock Color Chart can be used. Or the logger can subjectively judge the color using a set of standard colors. For this Work Plan the logger should subjectively judge the color using the following colors in combination:

- Brown;
- Yellow;
- Blue;
- Orange;
- Red;
- Grey; and,
- Olive.

No more than two colors should be combined, with the more dominant color being preceded by the secondary color and separated by a hyphen, e.g. “brown-gray”. The color description may be additionally modified by the terms “light” and “dark” as appropriate. For brevity, and to also distinguish subjective color descriptions from those of the Rock Color Chart, the “ish” suffix should be avoided.

Frequently, a sample has spots or patches which are colored differently from the bulk of the sample. This is called mottling. Where it occurs, the proper description includes the color of the bulk sample followed by the word “mottled,” followed by one or more of the color descriptions, e.g., “dark brown mottled tan.”

This is a description of the test sample behavior derived during the performance of the toughness test. Plasticity is described with the terms Nonplastic, Low, Medium, and High. Plasticity testing procedures are presented in Section 13.5 of Reference 2.1.

3.11 Moisture Content

The terms used to describe moisture content are dry, damp, moist, and wet, The moisture content is determined by feel. Dry is an unusual condition where the sample is completely desiccated as if it were baked in an oven. A damp sample will have enough moisture to keep the sample from being brittle, dusty or cohesionless and is darker in color that the same material in the dry state. A moist sample will leave moisture on your hand but displays no free water. A wet sample is one which is saturated and displays free water.

3.12 Estimated Grain Size Percents

The method of determining the percent composition of various grain sizes is largely visual except in distinguishing between silt and clay. When noting percentages, if all the fractions of all sizes in the sample are listed, they should total 100%.

When estimating percent of fines, because of the difficulties in distinguishing silt from clay, only the percent total fines should be estimated.

When describing gravel, the size of the clasts should be noted in inches, using "in." to symbolize inches. If the range of clasts begins just above coarse sand, then specify the largest size in a range of clasts, e.g. 20% gravel and cobbles to 5 inches.

When describing sand sizes, the terms fine, medium, and coarse are to be used.

3.13 Estimated Relative Permeability

Relative permeabilities are given as very low, low, low to moderate, moderate, moderate to high, high, and very high. It is extremely difficult to estimate the hydraulic permeability visually. Very high permeability materials are rare and usually occur as very well sorted gravels and sands with very little fine sediment. Generally, permeability decreases with degree of consolidation and amount of clay.

3.14 Odor

Odor is not usually mentioned unless a particular odor is detected. The absence of odor is only reported where the lack of it is diagnostic.

IMPORTANT: When contamination is severe enough to produce an odor without having to directly sniff the sample, i.e., free floating odors from around the borehole or an unbroken sample, all workers should put on respirators and halt work until the office has been contacted.

4.0 PROCEDURE

This section provides both the responsibilities and procedures involved with soil logging. The details within this SOP will be used in conjunction with the Final Work Plan for Western Dog Pens, Background, and Off-site Investigations.

4.1 Responsibilities

4.1.1 The Field Coordinator (FC) will be responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project Quality Assurance Specialist (PQAS) will be responsible for periodic review of field generated documentation associated with this SOP. The PQAS will also be responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and procedures, variances to QC sampling requirements, issuing non-conformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sampling activities will be responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff will be responsible for reporting deviations from procedures to the FC, Weiss Associates Project Manager, or the PQAS.

4.2 Soil Boring Logs

The Borehole/Well Construction Log Form is included as Attachment 1 to this SOP. Field personnel recording lithologic information during drilling will use this form. The procedures which will be followed in completing the Borehole/Well Construction Log Form, are outlined below.

As applicable, the following information will be filled in completely at the top of the first page of each boring log:

- Project Number;
- Project Name;
- Project Location;
- Rough Sketch with scale and north arrow depicting the approximate location of boring to structures, or other field landmarks;
- Boring Number;
- Name of Drilling Contractor;
- Name of Driller(s);
- Name of Field Geologist completing the form;
- Date and time drilling is started and completed;
- Drilling/Sampling Method;
- Type of Drill Rig used in collecting the samples;
- Driller’s C57 License Number; and,
- Borehole Diameter.

Each subsequent page of the Borehole/Well Construction Log should include:

- Photoionization (PID) or flame ionization detector (FID) readings recorded at the appropriate sample depth in units of parts per million (ppm);
- The instrument number of the PID used in the field;
- Borehole Completion and Sample Information (total borehole depth in feet, sample depth, sample description, blow counts, inches driven, inches recovered, sample condition);

- Borehole abandonment/completion information such as conductor casing(s) (interval and diameter), depth of sand pack and grout, well casing and screen depth; and,
- All depth or particle size numbers recorded as a decimal integer.

A daily field activity log will record the start of fieldwork and will be updated throughout the day by the field geologist/engineer. The daily field activity log will include:

- Date/Time and field activity description;
- Hours spent on field activity; and,
- A diary of daily activities, inspections, problems, conversations, visitors, weather conditions, and any other information relevant to the field activity.
- Samples collected for purposes other than soil classification are subject to handling, packaging, and shipping procedures described in SOP 2.1, Sample Handling , Packaging and Shipping.

4.3 Borehole Logging Procedures

The Borehole/Well Construction Log Form will be filled out accurately for each soil boring drilled and/or each soil boring attempted. Sample depths, locations and types will be recorded on the form. Boreholes that are logged entirely from cuttings and are not sampled must be indicated as such.

The log will contain a detailed description of the soil strata encountered and all pertinent information regarding drilling operations and estimated soil and ground water properties.

- Soil will be classified according to the Unified Soil Classification System (USCS) (Reference 2.1). The textural name for the soil will be written in the appropriate column using the USCS symbol.
- The format description for fine-grained sediments will include: textural classification (Silt, Sandy Silt, Clayey Silt, Sandy Clay, Silty Clay, Clay, Organic Silt, or Organic Clay); color, penetration resistance, moisture content, particle size distribution, estimated permeability, odor, miscellaneous (cementation, geologic origin, formation name, etc.).
- The format description of coarse-grained sediments will include: textural classification (Sand, Clayey Sand, Silty Sand , Gravelly Sand, Gravel, Clayey Gravel, Sandy Gravel); color, penetration resistance, moisture content, particle size distribution, grain shape, grain size, estimated permeability, odor, miscellaneous.
- A solid horizontal line and the appropriate depth in the USCS symbol column will mark abrupt soil changes. A dashed line will mark an apparent soil change. Diagonal lines will mark gradational changes. (Field personnel are best qualified to estimate the depth of changes. This task will not be delegated to office personnel, who have not observed the drilling operation.)

- Abbreviations will be used on the logs to save space for editing purposes.

Comments on the field log are extremely important. Some important aspects of the drilling operation that will be recorded are:

- The organic content of the soil and the depth of topsoil and roots;
- Any sudden change in the speed, sound, or penetration rate of the drill rig;
- If sampling is not continuous, drill cuttings will be used to complete the log; and,
- Any sample that is suspected of being disturbed, contaminated, or chemically or physically altered during the drilling process.

4.4 Surface Soil Lithologic Logs

Surface soil lithologic logs will be recorded on the daily field activity log and on the Sample Collection Log contained in SOP 3.1, Surface and Shallow Subsurface Soil Sampling, Attachment 1. This requires the FC/Field Geologist to make an illustration of the shallow sample location and record the:

- Project Number;
- Project Name;
- Project Location;
- Trench Number or Description; and,
- FC/Geologist Identity.

The following information will be recorded on the Sample Collection Log:

- Complete an accurate location sketch with dimensions to landmarks. Important features such as road intersections, corners of large buildings, or other man-made structures are best used. A north arrow will be included.

Samples collected for purposes other than soil classification are subject to handling, packaging, and shipping procedures as described in SOP 2.1.

Upon completion of shallow sample location, a completion note will be placed at the bottom of the last page of the Sample Collection Log, which will include:

- Sampling Completion at (Depth) Feet on (Date);
- Sampling Area Backfilled to Ground Surface on (Date); and,
- All depth numbers will be recorded in decimals.

4.5 Surface Soil Lithologic Logging Procedures

On the daily field activity log and Sample Collection Log in which the shallow boreholes or trenching are recorded, the following information will be included if appropriate:

- The sampler type. The abbreviations for sampler types are TW for thin-wall, P for piston, ST for Shelby Tube, and SS for standard split spoon. These abbreviations, or notations as to other sampler types, will be used in the "sampler type" column.
- Origin of sample. Specify if it is collected directly from the boring, a trench wall, or from an excavator bucket or shovel.
- The depth and location from which the sample originated. The sample depth is always measured to the top of the sample. A sample attempt where no sample is recovered will not be numbered, but the fact that a sampling attempt was made must be noted.
- The sample number.

The log will contain a detailed description of the soil strata encountered and all pertinent information regarding trenching operations and estimated soil and ground water properties.

- Soil will be classified according to the Unified Soil Classification System (USCS) (Reference 2.1). The textural name for the soil will be written on the excavation illustration at the appropriate depth interval.
- The format description for fine-grained sediments will include: textural classification (Silt, Sandy Silt, Clayey Silt, Sandy Clay, Silty Clay, Clay, Organic Silt, or Organic Clay); color, penetration resistance, moisture content, plasticity, particle size distribution, estimated permeability, odor, miscellaneous (cementation, geologic origin, formation name, etc.).
- The format description of coarse-grained sediments will include: textural classification (Sand, Clayey Sand, Silty Sand, Gravelly Sand, Gravel, Clayey Gravel, Sandy Gravel); color, penetration resistance, moisture content, particle size distribution, grain shape, grain size, estimated permeability, odor, miscellaneous.
- If abrupt soil changes are present, a solid horizontal line and the appropriate depth in the USCS symbol column will mark them. A dashed line will mark gradational soil changes. Diagonal lines should not be used. (Field personnel are best qualified to estimate the depth of changes. This task will not be delegated to office personnel, who have not observed the excavation operation.)
- Abbreviations will be used on the logs to save space for editing purposes.

Comments on the field log are extremely important. Some important aspects of the excavation operation that will be recorded follow:

- The organic content of the soil and the depth of topsoil and roots;
- Any sudden change in the speed, sound, or penetration rate of the excavation; and,

- Any sample that is suspected of being disturbed, contaminated, or chemically or physically altered during the excavation process.

5.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project record files.

6.0 ATTACHMENTS

6.1 Borehole/Well Construction Log

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

BOREHOLE/WELL CONSTRUCTION LOG

WEISS ASSOCIATES

BOREHOLE / WELL CONSTRUCTION LOG

Page ____ of ____

BOREHOLE LOCATION	Project: (facility, address, city, state)	Borehole/Well No:
		Job No:
	Logged By:	Edited By:
	Project Manager:	Drill Rig:
	Drilling Contractor: (name, city, state)	
	Driller:	License # : C57-
	Drilling Method:	Sample Method:
	Well Head Completion:	Ground Surface Elevation:
	Hammer Weight/Drop:	Borehole Diameter:
	Started, Time:	Date:
	Completed, Time:	Date:
	Water Depth	
Approximate Scale:	Boring/Casing Depth	
Notes:	Time	
	Date	

Sample ID	PID / FID (ppm)	Sampler Type / depth	Blows per 6 Inches	Inches Driven	Inches Recovered	Sample Condition	Boring Diameter	Diagram: Conductor Casing(s) Interval and Diameter	Diagram: Sand / Grout	Diagram: Well Casing / Screen	Depth in Feet	Recovery / Sample Loc.	Contact / Hyd. Conduct.	LITHOLOGIC DESCRIPTIONS
											1			
											2			
											3			
											4			
											5			
											6			
											7			
											8			
											9			
											10			

Total Boring Depth: | Total Well Depth:
Screened Interval: | Well Diameter:
Sand Pack (Type and Interval):
Well Development Method:
Time: | Date: | Flow Rate:
Geophysical Logs, Type:
By: | Date:

WEISS ASSOCIATES

BOREHOLE / WELL CONSTRUCTION LOG (cont.)

Page ____ of ____

Project / Job No.:

Borehole/Well No.:

Notes:

Sample ID	PID/FID	Sampler Type	Blows / 6 Inches	Inches Driven	Inches Recov'd	Sample Cond.	Boring Diameter	Conduct. Casing	Sand / Grout	Well Casing	Depth (ft)	Recovery	Contact
											1		
											2		
											3		
											4		
											5		
											6		
											7		
											8		
											9		
											0		
											1		
											2		
											3		
											4		
											5		
											6		
											7		
											8		
											9		
											0		

SAMPLE LABELING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for sample labeling. Sample labeling is required to identify, track and trace samples from the time of collection until the time of disposal. Additional specific procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14*

2.2 *EPA, August 1988, EPA Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.3 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Sample Label

Sample labels include all forms of sample identification (labels or tags) that are physically attached to samples collected and provide, at a minimum, the information required by this SOP and project work plans. An example sample label is shown as Attachment 6.1

4.0 PROCEDURE

This section contains both the responsibilities and procedures involved with sample labeling. Sample labeling is required to identify, track and trace samples from the time of collection until the time of disposal. The details within this SOP should be used in conjunction with the project work plans. The project work plans will commonly provide the following information:

- Sample collection objectives;
- Numbers, types and locations of samples to be collected; and,

- Any additional sample labeling requirements or procedures beyond those covered in this SOP, as necessary.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sample collection and labeling activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this sample labeling SOP. The PQAS is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to sample labeling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sampling and sample labeling activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 Sample Labeling

4.2.1 Document all the information necessary on the sample label and ensure that the label is physically attached to each respective sample. Each sample label must contain at a minimum the following information:

- Project name;
- Project number;
- Date and time of collection;
- Sample identification number; and,
- Collector's name.

Additional information may also be required per the project work plans and must accordingly be included on all sample labels.

4.2.2 Indelible ink should be used in filling out all sample labels.

4.2.3 Ensure that each sample collected has a sample label.

4.2.4 Ensure that the information documented on the sample label corresponds with the information documented on the Sample Collection Log (SOP 1.1), Water Sampling Data Form (SOP 5.1) and Chain-of-Custody Record (SOP 1.1).

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record file in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Example Sample Label

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

EXAMPLE SAMPLE LABEL

Weiss Associates
Environmental Science, Engineering and Management Services
5801 Christie Avenue, Suite 600, Emeryville, CA 94608
Phone: 510-450-6000 Fax: 510-547-5043

Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

Weiss Associates
Environmental Science, Engineering and Management Services
5801 Christie Avenue, Suite 600, Emeryville, CA 94608
Phone: 510-450-6000 Fax: 510-547-5043

Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

Weiss Associates
Environmental Science, Engineering and Management Services
5801 Christie Avenue, Suite 600, Emeryville, CA 94608
Phone: 510-450-6000 Fax: 510-547-5043

Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

Weiss Associates
Environmental Science, Engineering and Management Services
5801 Christie Avenue, Suite 600, Emeryville, CA 94608
Phone: 510-450-6000 Fax: 510-547-5043

Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

Weiss Associates
Environmental Science, Engineering and Management Services
5801 Christie Avenue, Suite 600, Emeryville, CA 94608
Phone: 510-450-6000 Fax: 510-547-5043

Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

Weiss Associates
Environmental Science, Engineering and Management Services
5801 Christie Avenue, Suite 600, Emeryville, CA 94608
Phone: 510-450-6000 Fax: 510-547-5043

Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

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Environmental Science, Engineering and Management Services
5801 Christie Avenue, Suite 600, Emeryville, CA 94608
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Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

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Job#:
Date: __________2010
Sample ID: LAB:
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Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

Weiss Associates
Environmental Science, Engineering and Management Services
5801 Christie Avenue, Suite 600, Emeryville, CA 94608
Phone: 510-450-6000 Fax: 510-547-5043

Job#:
Date: __________2010
Sample ID: LAB:
Initials: Time:
Analysis:
Preservative:
Analytical Method:

SAMPLE NUMBERING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for sample numbering. Sample numbering is required to identify, track and trace samples from the time of collection until the time of disposal. Additional specific procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a,OSWER 9355.0-14*

2.2 *EPA, August 1988, EPA Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.3 *SOP 17.1 - Sample Labeling*

2.4 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Sample Number

A sample number is a unique alphanumeric identification assigned to each and all physical samples collected as part of any given project.

4.0 PROCEDURE

This section contains both the responsibilities and procedures involved with sample numbering. Sample numbering is required to provide a means by which samples can be identified, tracked and traced from the time of collection until the time of disposal. The details within this SOP should be used in conjunction with project work plans. The project work plans will generally provide the following information:

- Sample collection objectives;
- Numbers, types, and locations of samples to be collected;
- Project-specific character string to be used for the sample numbering;
- Person responsible for issuing sample numbers to field personnel conducting sampling activities; and,
- Any additional sample numbering requirements or procedures beyond those covered in this SOP, as necessary.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sample collection and numbering activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to sample numbering requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to sampling and sample numbering activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Field Coordinator or the PQAS.

4.2 Sample Numbering

4.2.1 The alphanumeric character string will be determined on a project-specific basis and stated in the project work plans. The sample numbers should be as simple and preferably as short as possible; however, they should also be compatible with the laboratory analytical tracking system and the data management system to be used for the project sample data.

4.2.2 A unique sample number will be assigned in the field to each sample to be submitted for analysis.

4.2.3 Both environmental (soil, sediment, ground water, air, etc.) and QC samples will be assigned sample numbers with the same prefix so that the laboratory will be unable to distinguish between the QC and non-QC samples.

4.2.4 The sample number will be recorded, using indelible ink, directly on the sample label attached to each sample per SOP 17.1. Prenumbered tape may also be used and affixed to each sample; however, their use is not mandatory for this SOP. When used, the sample number on the preprinted tape must also be recorded on the sample label.

4.2.5 The sample number must also be recorded on the Sample Collection Log (SOP 1.1), Sampling Information Form for ground water samples (SOP 5.1), and Chain-of-Custody Record (SOP 1.1).

4.2.6 It is recommended that one person (either the Field Coordinator or other designee) be responsible for issuing sample numbers to field sampling personnel and ensuring that the sample sequence numbers are applied to samples in the sequence in which they are collected.

4.2.7 It is also recommended the Field Coordinator or designee be responsible for keeping a master sample log listing the sample numbers and a brief description of the samples collected.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

FIELD QC SAMPLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for conducting field quality control (QC) sampling. Field QC sampling is required to assist in verifying the quality and integrity of samples collected during a given sampling event. Additional specific field QC sampling procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *EPA, September 1987, Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14*

2.2 *EPA, August 1988, EPA Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.3 *SOP 1.1 - Chain-of-Custody*

2.4 *SOP 2.1 - Sample Handling, Packaging and Shipping*

2.5 *SOP 9.1 - Ground Water Sampling*

2.6 *SOP 17.1 - Sample Labeling*

2.7 *SOP 17.2 - Sample Numbering*

2.8 *SOP 19.1 - On-Site Sample Storage*

2.9 *SOP 20.1 - Sample Collection, Preservation, and Holding Times*

2.10 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Field QC Sample

A field QC sample is a physical sample collected during or for a specific sampling event. The purpose of this sample is to evaluate the quality and integrity of original samples collected during the specific sampling event.

4.0 PROCEDURE

This section contains both responsibilities and requirements for field QC sampling. Field QC sampling is required to provide data to verify the quality and integrity of environmental samples collected during a given sampling event.

The details within this SOP should be used in conjunction with project work plans. The project work plans will generally provide the following information:

- Sample collection objectives;
- Numbers, types and locations of environmental (non-QC) samples to be collected;
- Numbers and types of supportive QC samples to be collected; and,
- Any additional QC sampling requirements or procedures beyond those covered in this SOP, as necessary.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all sample collection activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Field personnel assigned to environmental and QC sampling activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Field Coordinator or the PQAS.

4.2 Quality Control Sampling Requirements

4.2.1 Field QC samples may consist of different media. Typical QC samples are as follows:

- Trip blank (TB);
- Equipment rinsate (ER);
- Field blank (FB); and,
- Field duplicate (FD).

4.2.2 Trip blanks are analyte-free water, shipped from and returned unopened to the laboratory in the same shipping containers for volatile organics. The blanks are prepared at the laboratory using ASTM Type II DI Water, sent to the project location, carried with the sampling team(s) during sampling, and shipped to the laboratory for analysis with the environmental samples.

4.2.3 Trip blank samples are commonly collected and analyzed at a rate of one per sample cooler containing samples for volatile organic analyses. The number or rate of trip blanks to be collected and the specific analyses to be conducted for the trip blanks will be provided in the project work plans.

4.2.4 Equipment rinsate samples are collected from the final rinse water during decontamination of ground water, soil, or waste sampling equipment. This type of equipment includes bailers, splitspoon samplers, soil sample sleeves, hand augering equipment, surface soil sampling equipment, purge and sample pumps, etc.

4.2.5 Rinsate samples are generally collected at a rate of one per day per sampling team during the sampling event. Equipment rinsates are usually collected from re-usable sampling equipment only. The number or rate of equipment rinsate samples to be collected for a particular project will be specifically developed and documented in the project work plans. The specific chemical analyses to be conducted for the rinsate samples will also be developed and documented in the project work plans.

4.2.6 Field blanks are prepared from the water which is used for decontamination. One sample from each sampling event and each water source or lot number is generally collected and analyzed for all parameters of interest for the project. Upon collection, a description of the water source for the field blank sample should be documented in the Sample Collection Log (SOP 1.1).

4.2.7 The number or rate of field blank samples to be collected for a particular project will be specifically developed and documented in the project work plans. The specific chemical analyses to be conducted for the field blank samples will also be developed and documented in the project work plans.

4.2.8 For soils, field duplicate samples are generally collected by co-located sampling (e.g., using successive sample tubes from the same split spoon sampling run) or by splitting samples. Field duplicate water samples are commonly collected by retaining consecutive samples from the sampling device (e.g., bailer or sample pump discharge line). Field duplicate water samples may also be generated by splitting a collected volume; however, this practice may lead to a loss in volatile organic compounds and is not common practice for volatile analyses.

4.2.9 Field duplicate samples are commonly collected at a rate of 5 to 10 percent per media sampled. However, the number or rate of field duplicate samples to be collected for a particular project will be specifically developed and documented in the project work plans. The specific chemical analyses to be conducted for the field duplicates will also be developed and documented in the project work plans.

4.2.10 The type and number of QC samples collected for a particular project is based on specifications provided in project specific documents, i.e., the project work plans. Field QC samples are to be collected at appropriate times during a sampling event.

4.2.11 All field QC samples will be collected in proper containers with appropriate preservation per SOP 20.1 and the project work plans.

4.2.12 The collection of field QC samples consisting of various media (e.g., soil, ground water, etc.) will follow procedures in sample collection SOPs for the respective media and any other applicable procedures in the project work plans. For example, the collection of a ground water field duplicate QC sample will follow procedures specified in the ground water sampling SOP (SOP 9.1). Equipment rinsate samples are collected directly while rinsing the sampling equipment following appropriate procedures in SOP 9.1 and the project work plans. Field blank samples are collected by pouring decontamination water directly into sample containers following appropriate protocol in SOP 9.1 and the project work plans.

4.2.13 Field QC samples will be labeled and numbered as described in SOPs 17.1 and 17.2 respectively and the project work plans.

4.2.14 The field QC samples will also be maintained under custody per SOP 1.1, and be appropriately stored, handled and shipped per SOPs 19.1 and 2.1, respectively.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ON-SITE SAMPLE STORAGE

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for on-site sample storage. On-site sample storage may be required for samples collected during a given project. Additional on-site sample storage procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *EPA, September 1987. Compendium of Superfund Field Operations Methods, EPA 540/P-87/001a, OSWER 9355.0-14*

2.2 *EPA, August 1988. EPA Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, Interim Final OSWER Directive 9355.3-01*

2.3 *SOP 1.1 – Chain-of-Custody*

2.4 *SOP 2.1 - Sample Handling, Packaging and Shipping*

2.5 *SOP 17.1 - Sample Labeling*

2.6 *SOP 17.2 - Sample Numbering*

2.7 *SOP 20.1 - Sample Collection, Preservation, and Holding Times*

2.8 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Field Sample

A sample that has been collected at a project site, during the execution phase of the project, and for the purposes of the project, as defined in the project work plans.

3.2 On-Site

For purposes of this SOP, "on-site" is defined as any area within the project site.

3.3 On-Site Sample Storage

For purposes of this SOP, "on-site sample storage" applies to samples stored within the project site for a temporary period of time. Typically, samples may be stored on-site if they are in transit between the project site and a designated laboratory.

4.0 PROCEDURE

This section contains both responsibilities and requirements pertaining to on-site sample storage. Proper storage is essential to maintain the quality and integrity of samples collected during a field project.

The details within this SOP should be used in conjunction with project work plans. At a minimum, the project work plans will provide the following information:

- Sample collection objectives;
- Numbers, types and locations of samples to be collected; and,
- Any additional on-site sample storage requirements or procedures beyond those covered in this SOP, as necessary.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all on-site sample storage activities are conducted in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Specialist (PQAS) is responsible for periodic review of field generated documentation associated with this SOP. The PQAS is also responsible for Implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to sample storage requirements, issuing nonconformance, etc.) if problems occur.

4.1.3 Field personnel assigned to sample storage activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Field Coordinator or the PQAS.

4.2 On-Site Sample Storage Requirements

4.2.1 Samples of all types of media may required to be stored on-site. The manner in which these samples are stored will be appropriate for individual samples or each sample type.

4.2.2 Samples collected for chemical analysis are typically required to be stored at approximately 4° Centigrade (°C). Therefore, such samples should either be preserved using water ice, and/or in a "Sample-only" refrigerator until received by the assigned laboratory. Blue ice is not recommended for on-site sample storage as it does not maintain the 4°C temperature necessary for regulatory compliance. If a refrigerator is used to store samples at the project site, this refrigerator will be dedicated for the sole use of samples; no food, drinks or other personal items will be allowed in this refrigerator.

4.2.3 Samples that do not require refrigeration (e.g. air samples and samples for geotechnical or radionuclide analysis) should be stored on-site in a designated, marked area.

4.2.4 Samples that are stored on-site must be stored in appropriate containers per SOP 20.1 and the project-specific work plans and be maintained under custody per SOP 1.1.

4.2.5 Samples that are stored on-site must not be stored in a manner in which they may threaten the integrity of other samples in the holding location.

4.2.6 All samples that are stored on-site must be labeled per SOP 17.1, numbered per SOP 17.2, and appropriately handled per SOP 2.1.

4.2.7 It is recommended the Field Coordinator or other designee be responsible for maintaining a master sample log listing sample numbers and a brief description of samples collected. The master log should be reviewed regularly for samples that are under storage on site. The samples should then be appropriately shipped, following procedures per SOP 2.1, to ensure that holding time are not missed.

4.2.8 Samples that are not shipped to the assigned laboratory should be disposed of in a timely manner following appropriate disposal practices for the media from which the samples were initially obtained.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be maintained in the project records file in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This standard operating procedure (SOP) provides guidance on the selection of suitable containers for samples, volume requirement, holding times, and recommended preservation techniques for water, wastes, sediments, sludges and soil samples.

2.0 REFERENCES

2.1 *Korte, N. and P. Kearl, 1985. Protection for the Collection and Preservation of Ground Water and Surface Water Samples and for the Installation of Monitoring Wells, 2nd ed., U.S. Department of Energy, GJ/TMC-08, Technical Measurements Center, Grand Junction Projects Office.*

2.2 *RCRA, 1986. Ground Water Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, September 1986.*

2.3 *SOP 1.1 - Chain-of-Custody*

2.4 *SOP 2.1 - Sample Handling, Packaging and Shipping*

2.5 *SOP 6.1 - Sampling Equipment and Well Material Decontamination*

2.6 *SOP 9.1 - Ground Water Sampling*

2.7 *SOP 17.1 - Sample Labeling*

2.8 *SOP 17.2 - Sample Numbering*

2.9 *U.S. Environmental Protection Agency, 1985. Practical Guide for Ground Water Sampling, EPA/600/2-85/104, Washington, D.C.*

2.10 *U.S. Environmental Protection Agency, 1984. Test Methods for Evaluation of Solid Waste, EPA-SW-846, 2nd ed., Washington, D.C.*

2.11 *U.S. Environmental Protection Agency, 1983. Manual of Ground Water Quality Sampling Procedures, EPA/600/2-85/104, Washington, D.C.*

2.12 *U.S. Environmental Protection Agency, 1983. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Washington, D.C.*

2.13 *U.S. Environmental Protection Agency, 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater, EPA-600/2-85/104, Washington, D.C.*

3.0 DEFINITIONS

3.1 Field Sample

A sample that has been collected at a project site, during the execution phase of the project, and for the purposes of the project, as defined in the project work plans.

4.0 PROCEDURE

As a general guide in choosing a sample container, the ideal construction material should be non-reactive with the sample, especially with the particular analytical parameter to be tested.

Glass, polyethylene, or brass containers must be used when analyzing samples for organic compounds to prevent introduction of extraneous organic compounds, such as those that might be leached from plastic containers. The rigid plastic screw caps for the bottles and polyethylene caps for brass core tubes must be Teflon-lined to prevent contamination.

Once a sample has been collected, steps must be taken to preserve the sample's chemical and physical integrity during transport and storage prior to analysis. The type of sample preservation required will vary according to the sample type and the parameter to be measured.

4.1 Preparation

4.1.1 Office: The LEHR QAPP and task-specific work plans will establish the number, type and analyses of field samples, including field analyses. Calculations should then be made to determine the number and type of containers required for the sampling effort. Sample containers will vary according to the matrix and nature of the sample to be collected. Wide-mouth containers are generally used for wastes, narrow-mouth vials for water and brass core tubes for sediments/soils.

4.1.2 Container Type:

- Identify the containers required for all analyses by matrix as shown in Attachments 6.2 and 6.3 (e.g., one amber glass, narrow-mouth bottle for PCB analysis of water samples).
- Calculate the number of each type of container required by including duplicates, blanks, and tares with the number of samples as specified in the task work plan.

4.1.3 Container Cleaning: Containers are usually obtained from suppliers pre-cleaned to EPA specifications.

4.1.4 Sample Volume: The volume of sample collected should be sufficient to perform all the required analyses plus an additional amount to provide for any quality control needs, split samples, or repeat examination. The volumes presented in Attachments 6.2 and 6.3 are intended as general guidance only. The laboratory receiving the sample should be consulted for specific volume requirements.

4.1.5 Sample Preservation: Preservation required for specific analyses requested may be determined from Attachments 6.2 and 6.3.

4.1.6 Field: The appropriate number and type of pre-cleaned containers along with preservatives, equipment and packaging containers should be ready for field sampling.

4.2 Operation

4.2.1 Wastes/Sludges Sample Collection.

- While wearing tale-free surgical gloves, fill the bottle as full as possible with the sample. Wet wastes should have enough headspace to allow for expansion.
- Extreme care must be taken to avoid contamination of the bottles or caps. The cap should be removed just prior to filling and replaced as soon as possible after filling. Any contact with the inside of the bottle or cap by anything other than the sample must be avoided. Gloves should be discarded after packaging of each sample.
- Clean exterior of bottle with a wipe moistened with deionized water. Affix a sample label completed per SOP 17.1, Sample Labeling, and cover with clear tape. The tape should extend at least ¼ inch beyond the edges of the label.
- Preservation of soil samples is usually accomplished by protecting the sample from UV light by the use of an amber bottle and keeping the sample cool.
- Place sample containers in Ziplock-type plastic bags. Place container in cooler, if required. Maintain ~4ºC temperature; avoid freezing the sample.
- If samples are not delivered to the laboratory on a daily basis, ice chests and insulated boxes should be checked every 24 hours and thawed ice replaced with ice, as needed.

- Even if no specific preservation is recommended, avoid exposing the sample to extreme hot or cold temperatures and intense sunlight.
- Use and discard gloves for each sample.

4.2.2 Sediments/Soils Sample Collection: Specific methods to be used for drilling for the sample vary, depending on whether the sample is retrieved from saturated or unsaturated zones. The handling of the samples themselves is summarized as follows:

- Collect the sample for analytical laboratory analysis from the first tube from the coring device (i.e., the deepest tube), provided sample quality is good (i.e., no headspace); this will maximize sample integrity.
- Quickly seal the brass tube ends with a sheet of Teflon and high-density polyethylene caps. Wrap the caps with tape.
- Label the sample tube with an indelible marker with sample orientation, borehole name, sampling date, analysis type(s), company name, and job number. Seal the samples into Ziplock-type plastic bags.
- Refrigerate the sample immediately after labeling in ice chests with ice or double-bagged water ice. If the sediments are to be submitted for tritium analysis, they should be frozen as soon as possible.
- If samples are not delivered to the laboratory on a daily basis, ice chests and insulated boxes should be checked every 24 hours and thawed ice replaced with frozen ice as needed.
- Even if no specific preservation is recommended, avoid exposing the sample to extreme hot or cold temperatures and intense sunlight.

4.2.3 Water Sample Collection

- Do <u>not</u> rinse container with sample water.
- Following presample purging and field tests, collect samples directly in the appropriate container with preservatives, as required (e.g., Na2SO4 for fuel hydrocarbon samples).
- Do not filter unless specifically requested in the task work plan.
- Slowly fill container by allowing water to flow down the side to avoid turbulence. Fill each container almost full except for VOA samples. VOA samples should be filled completely. Then inverted after the cap is put on to make sure no bubbles are present.
- Where required, add acid preservatives. Cap container, shake and re-open. Check pH adjustment with pH paper. If necessary, add more preservative. Re-cap; use Parafilm seal, if required.
- If an error was made in collection, discard the entire bottle and start with a new one.

- Avoid contamination of the bottle and cap during sample collection.
- Use and discard talc-free gloves for each sample.

4.2.4 Holding times: In general, samples should be analyzed as soon as possible after collection. Some parameters are analyzed in the field. Allowable holding times listed are provided only as guidance and are the maximum times for which samples are still considered valid Arrangements should be made to deliver the samples to the laboratory as expediently as possible from the field site. (See SOP 2.1, Sample Handling, Packaging, and Shipping).

5.0 RECORDS

Records generated as a result of implementation of this SOP will be maintained in the project records file in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 *Equipment Checklist*

6.2 *Table 1. Recommendation for Sampling Volumes, Containers, Preservation and Holding Times of Water Samples*

6.3 *Table 2. Recommendation for Sampling Volumes, Containers, Preservation and Holding Times of Sediment/Soil Samples*

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

EQUIPMENT CHECKLIST

ATTACHMENT 6.1

EQUIPMENT CHECKLIST

______________ Narrow-Mouth Amber Glass Bottles with Teflon-Lined Caps (0.5, 1, and 2-L)
______________ Glass Vials with Teflon Septa (40-mL)
______________ Water Ice or Equivalent
______________ 250-mL Sterile Bottle
______________ Cardboard Boxes
______________ Insulated Coolers
______________ Ball-Point Pen (permanent black ink)
______________ Felt-Tip Marker Pen (permanent black ink)
______________ Heavy Duty Plastic Bags, Ties
______________ Strapping Tape
______________ Wide-Mouth Polyethylene Bottles (0.5, 1, and 2-L)
______________ Plastic Trash-Can Liners
______________ 1-11 pH Indicator Paper
______________ Disposable Surgical Gloves (latex, PVC, or other suitable plastic or rubber)
______________ Disposable Wipes
______________ Deionized Water
______________ Padding for Packaging of Samples
______________ New or Cleaned Polyethylene Narrow-Mouth Bottles (1.0-L, 500, 125, and 60-mL)

ATTACHMENT 6.2

RECOMMENDATION FOR SAMPLING VOLUMES, CONTAINERS, PRESERVATION AND HOLDING TIMES OF WATER SAMPLES

ATTACHMENT 6.2

Table 1. Recommendation for Sampling Volumes, Containers, Preservation and Holding Times of Water Samples[1]

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Physical Properties				
Color	50	P, G	Cool, 4ºC	48 Hrs.
Conductance	100	P, G	Cool, 4ºC	28 Days
Hardness	100	P, G	HNO_3 to pH<2	6 Mos.
Odor	200	G only	Cool, 4ºC	24 Hrs.
pH	250	P, G	None Required	Analyze Immediately
Residue				
Filterable	100	P, G	Cool, 4ºC	7 Days
Non-Filterable	100	P, G	Cool, 4ºC	7 Days
Total	100	P, G	Cool, 4ºC	7 Days
Volatile	100	P, G	Cool, 4ºC	7 Days
Settleable Matter	1,000	P, G	Cool, 4ºC	48 Hrs.
Temperature	1,000	P, G	None Required	Analyze Immediately
Turbidity	100	P, G	Cool, 4ºC	48 Hrs.
Metals				
Dissolved	200	P, G	Filter; HNO_3 to pH<2	6 Mos.[6]
Suspended	200	P, G	Filter on-site	6 Mos.
Total	100	P, G	HNO_3 to pH<2	6 Mos.
Chromium^{+6}	200	P, G	Cool, 4ºC	24 Hrs.
Mercury				
Dissolved	100	P, G	Filter; HNO_3 to pH<2	28 Days[6]
Total	100	P, G	HNO_3 to pH<2	28 Days
Inorganics, Non-Metallics				
Acidity	100	P, G	Cool, 4ºC	14 Days
Alkalinity	100	P, G	Cool, 4ºC	14 Days
Bromide	100	P, G	None Required	28 Days
Chloride	50	P, G	None Required	28 Days
Chlorine	200	P, G	None Required	Analyze Immediately
Cyanides	500	P, G	None Required	28 Days
Flouride	300	P	None Required	28 Days[7]
Iodide	100	P, G	Cool, 4ºC	24 Hrs.
Nitrogen		P, G		
Ammonia	400	P, G	Cool, 4ºC; H_2SO_4 to pH<2	28 Days
Kjeldahl, Total	500	P, G	Cool, 4ºC; H_2SO_4 to pH<2	28 Days
Nitrate Plus Nitrite	100	P, G	Cool, 4ºC; H_2SO_4 to pH<2	28 Days
Nitrate[8]	100	P, G	Cool, 4ºC	48 Hrs.
Nitrate	50	P, G	Cool, 4ºC	48 Hrs.
Dissolved Oxygen				
Probe	300	G bottle and top	None Required	Analyze Immediately
Winkler	300	G bottle and top and store in dark	Fix on-site	8 Hrs.
Phosphorus				
Orthophosphate, Dissolved	50	P, G	Filter; Cool, 4ºC	48 Hrs.
Hydrolyzable	50	P, G	Cool, 4ºC; H_2SO_4 to pH<2	28 Days
Total, Dissolved	50	P, G	Filter; Cool, 4ºC; H_2SO_4 to pH<2	24 Hrs.
Silica	50	P only	Cool, 4ºC	28 Days
Sulfate	50	P, G	Cool, 4ºC	28 Days
Sulfide	50	P, G	Cool, 4ºC; add 2 mL zinc acetate plus NaOH to pH>9	7 Days
Sulfite	50	P, G	None Required	Analyze Immediately

Measurement	Volume Requirement (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
Bacterial				
Coliform, Fecal and Total	250	P, G sterile	Cool, 4ºC	6 Hrs.
Organics				
BOD	1,000	P, G	Cool, 4ºC	48 Hrs.
COD	50	P, G	Cool, 4ºC; H_2SO_4 to pH<2	28 Days
Oil and Grease	1,000	P, G	Cool, 4ºC; H_2SO_4 to pH<2	28 Days
Organic Carbon	25	P, G	Cool, 4ºC; H_2SO_4 or HCI to pH<2	28 Days
Phenols	1,000	G, Teflon-lined	Cool, 4ºC; 0.008% $Na_2S_2O_3$[9]	7 Days until extraction 40 Days after extraction
Purgeable Volatile Halogens	2 x 40-mL vial	G, Teflon-lined septum, no head space	Cool, 4ºC	7 Days
Purgeable Aromatics	2 x 40-mL vial	G, Teflon-lined septum	Cool, 4ºC; 0.008% $Na_2S_2O_3$[9] HCI to pH<2	14 Days[10]
Acrolein and Acrylonitrile	1,000	G, Teflon-lined septum	Cool, 4ºC; 0.008% $Na_2S_2O_3$[9]	14 Days
Benzindines	1,000	G, Teflon-lined cap	Cool, 4ºC; 0.008% $Na_2S_2O_3$[9]	7 Days until extraction 40 Days after extraction
Phthalate Esters	1,000	G, Teflon-lined cap	Cool, 4ºC; 0.008% $Na_2S_2O_3$[6]	7 Days until extraction 40 Days after extraction
Nitrosamines	1,000	G, Teflon-lined cap	Cool, 4ºC; store in dark 0.008% $Na_2S_2O_3$[6]	7 Days until extraction 40 Days after extraction
Nitroaromatics and Isophorone	1,000	G, Teflon-lined cap	Cool, 4ºC	7 Days until extraction 40 Days after extraction
Polynuclear Aromatic Hydrocarbons	1,000	G, Teflon-lined cap	Cool, 4ºC	7 Days until extraction 40 Days after extraction
Haloethers	1,000	G, Teflon-lined cap	Cool, 4ºC	7 Days until extraction 40 Days after extraction
Chlorinated	1,000	G, Teflon-lined cap	Cool, 4ºC	7 Days until extraction 40 Days after extraction
TCDD	1,000	G, Teflon-lined cap	Cool, 4ºC	7 Days until extraction 40 Days after extraction
Pesticides Tests				
Pesticides	1,000	G, Teflon-lined cap	Cool, 4ºC	7 Days until extraction 40 Days after extraction
Radiological Tests				
Gross Alpha, Beta	1,000	P, G	HNO_3 to pH<2	6 Mos.
Gamma Spectrum	1,000	P, G	HNO_3 to pH<2	6 Mos.
Tritium	250	P	Freeze at 0ºC	6 Mos.

Notes:

[1] More specific instructions for preservation and sampling are found in Code of Federal Regulations, 40, Part 136, 1987.
[2] Plastic (P) or Glass (G) or Brass (B). For metals, polyethylene with a polypropylene cap (no liner) is preferred.
[3] Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When a large volume sample is collected for subsequent subsampling and it is impossible to preserve each aliquot, then samples may be preserved by maintaining a 4ºC until compositing and sample splitting is completed.
[4] When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance.
[5] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid.
[6] Samples should be filtered immediately on-site before adding preservative for dissolved metals.
[7] Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added.
[8] For samples from non-chlorinated drinking water supplies, conc. H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analyzed before 14 days.
[9] Should only be used in the presence of residual chlorine.
[10] Unpreserved samples must be analyzed within 7 days.

ATTACHMENT 6.3

RECOMMENDATION FOR SAMPLING VOLUMES, CONTAINERS, PRESERVATION AND HOLDING TIMES OF SEDIMENT/SOIL SAMPLES

ATTACHMENT 6.3

Table 2. Recommendation for Sampling Volumes, Containers, Preservation and Holding Times of Sediment/Soil Samples[1]

Measurement	Volume Requirement (g)	Container[2]	Preservative[3]	Holding Time[4]
Organics				
Total Organic Carbon	20	B, Teflon-lined caps	None required	14 Days until drying/ 6 Mos. after drying
Total Organic Halogens	50	B, Teflon-lined caps	Cool, 4ºC	14 Days
Base/neutral/acid Extractable Compounds, and PCBs/pesticides	50	B, Teflon-lined caps	Cool, 4ºC	7 Days until extraction/ 40 Days after extraction
Metals				
STLC[5] Extraction	100	P, G, B, Teflon-lined caps	Cool, 4ºC	28 Days
Hexavalent Chromium	20	P, G, B, Teflon-lined caps	Cool, 4ºC	24 Hrs.
Radiological Tests				
Gross Alpha, Beta and Gamma Spectrum	50	B, Teflon-lined caps		6 Mos.
Tritium	50	B, Teflon-lined caps	Freeze at 0ºC	6 Mos.

Notes:

[1] More specific instructions for preservation and sampling are found in Code of Federal Regulations, 40, Part 136, 1987.
[2] Polyethylene (P) or Glass (G) or Brass (B).
[3] When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance.
[4] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid.
[5] Soluble Threshold Limit Concentration extraction procedures for Hazardous Waste Identification, State of California Administrative Code, Title 22, Section 66700.

DATA VALIDATION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for data validation. Data validation is required to assess the data quality and usability, and to ensure that data are accurate and dependable. Additional specific procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 *US EPA, June 2008, US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, EPA-540-R-08-01~~EPA, February 1994, US EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA-540/R-94/012~~*

2.2 *US EPA, January 2010, US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, EPA 540-R-10-011~~EPA, February 1994, US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA-540/R-94/013~~*

Comment [AS1]: No. 16 (previous SC 48)

2.3 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

3.1 Data Validation

Data validation is a systemic process for reviewing and qualifying data, to provide assurance that the data are adequate for their intended use. During the validation process, all results will be identified as either acceptable for use, estimated and acceptable for use, or rejected and unacceptable for use.

4.0 PROCEDURE

This section contains both the responsibilities and procedures involved with data validation.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all data validation activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project QA Manager (PQAM) is responsible for periodic review of documentation associated with this data validation SOP. The PQAM is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to data validation requirements, issuing nonconformances, etc.) if problems occur.

4.1.3 Personnel assigned to data validation activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the PQAM.

4.2 Data Validation

4.2.1 Data validation will be performed using ~~the~~ checklists and referring to the guidance of the "US EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review~~USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review~~ (U.S. EPA, ~~1994~~2008)" and "US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review ~~USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review~~ (U.S. EPA, ~~1994~~2010)." Checklists for organic, metals, general chemistry, and radiochemistry data validation are provided in Attachment 6.1.

- The organic data will be reviewed for holding times, blank analysis results, GC/MS tuning, instrument calibrations, internal standard retention times and areas, laboratory control samples (LCS), matrix spike/matrix spike duplicate (MS/MSD), ~~and~~ surrogate recovery, manual integrations, second column confirmations, and field duplicates;
- ~~The m~~Metals data will be reviewed for holding times, blank analysis results, matrix spikes, post-digestion spikes, sample duplicates, laboratory control samples, instrument initial and continuing calibration, ICP interference check samples, ICP serial dilutions, and field duplicates~~,~~ ;
- ~~general~~ General chemistry and radiochemistry data will be reviewed for holding times, blank analysis results, MS, MSD/sample duplicates, relative error ratio (radiochemistry only), LCS, and instrument calibrations; and,
- Analytical results will be qualified as a result of the data validation process in accordance with the qualifying conventions as listed in Attachment 6.2.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record file in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 *Data Validation Checklists*

6.2 *Data Validation Qualifier Definitions*

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

DATA VALIDATION CHECKLISTS

VALIDATION OF ORGANIC DATA BY GC/MS ANALYSIS

Lab: ______________________ Date: ______________________

Analysis: ______________________ SDG #: ______________________

HOLDING TIMES

Have all SVOC samples been extracted within holding times? Yes ☐ No ☐ N/A ☐

If any sample fails this criterion, apply qualifiers to all results in the sample according to the following guidelines:

Condition	Positives	Non-Detects
15 Days ≤ Soil Sampling → Extraction ≤ 28 Days	"J"	"UJ"
Soil Sampling → Extraction > 28 Days	"J"	"R"
8 Days ≤ Water Sampling → Extraction ≤ 14 Days	"J"	"UJ"
Water Sampling → Extraction > 14 Days	"J"	"R"

Have all samples been analyzed within holding times? Yes ☐ No ☐ N/A ☐

If any sample fails this criterion for the VOC fraction, apply qualifiers to all results in the sample according to the following guidelines:

Condition	Positives	Non-Detects
15 Days ≤ VOC Sampling → Analysis ≤ 28 Days	"J"	"UJ"
VOC Sampling → Analysis > 28 Days	"J"	"R"

If any sample fails this criterion for the SVOC fraction, apply qualifiers to all results in the sample according to the following guidelines:

Condition	Positives	Non-Detects
41 Days ≤ BNA Extraction → Analysis ≤ 80 Days	"J"	"UJ"
BNA Extraction → Analysis > 80 Days	"J"	"R"

SYSTEM MONITORING COMPOUNDS (SURROGATES)

Are all surrogate recoveries in all samples within QC limits? Yes ☐ No ☐ N/A ☐

If any surrogate failures are observed in a sample for the VOC fraction, apply qualifiers to all results in the sample according to the following guidelines:

Condition	Positives	Non-Detects
%R > Upper Limit	"J"	No qualifiers
10% ≤ %R < Lower Limit	"J"	"UJ"
%R < 10%	"J"	"R"

If any surrogate failures are observed in a sample for either the Base/Neutral or Acid fractions, apply qualifiers to all results in the sample, for that fraction, according to the following guidelines:

Condition	Positives	Non-Detects
1 %R out & > 10%	No qualifiers	No qualifiers
2 or more %R out, > Upper Limit	"J"	No qualifiers
2 or more %R out, < Lower Limit and all > 10%	"J"	"UJ"
1 or more %R < 10%	"J"	"R"

QC CHECK SAMPLE (LCS)

Are all LCS recoveries within QC limits? Yes ☐ No ☐ N/A ☐

If any LCS compound fails this criterion, apply qualifiers to the failed compound in all samples associated with that LCS, according to the following guidelines:

Condition	Positives	Non-Detects
%R > Upper Limit	"J"	No qualifiers
30% ≤ %R < Lower Limit	"J"	"UJ"
%R < 30%	"J"	"R"

If failures are widespread and consistent in the direction of the failure, then an overall analytical bias can be determined for this fraction.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD)

	Yes	No	N/A
Are all MS/MSD recoveries and relative percent difference (RPD) within QC limits?	☐	☐	☐

MS/MSD data are used in conjunction with LCS data to identify and describe interferences. If LCS recoveries indicate a similar bias, then the bias can be determined to be analytical in nature. If LCS recoveries are in control, then the bias can be identified as a matrix effect.

BLANKS

Are the following free of contamination?	Yes	No	N/A
Method blanks	☐	☐	☐
Trip blanks (if present)	☐	☐	☐
Field/Rinsate blanks (if present)	☐	☐	☐

Use the following steps when qualifying data based on blank contamination.

- Identify all individual data points that are associated with a blank contaminant.
- For any data point associated with contamination from more than one blank, select the blank with the highest concentration of the contaminant. The sample data point will be compared to this contaminant for qualifying purposes.
- Convert the concentration of the selected contaminant to the actual contamination level. Divide the contamination concentration by the blank detection limit and multiply by the sample detection limit.
- Qualify all data points associated with a common laboratory contaminant (acetone, 2-butanone, methylene chloride, or common phthalates) according to the following guidelines:

Condition	Flag
No Positive Sample Result	None
Positive Sample Result < 10x Contamination Level	"UJ"
Positive Sample Result > 10x Contamination Level	None

- Qualify all data points associated with any other laboratory contaminant according to the following guidelines:

Condition	Flag
No Positive Sample Result	None
Positive Sample Result < 5x Contamination Level	"UJ"
Positive Sample Result > 5x Contamination Level	None

GC/MS INSTRUMENT PREFORMANCE CHECKS (TUNES)

Are all ion abundances within QC limits for each tune? Yes ☐ No ☐ N/A ☐

If any ion abundances do not fall within QC limits, qualify all results in all related samples "R".

INITIAL CALIBRATIONS (ICs)

Are all RRFs greater than 0.05? Yes ☐ No ☐ N/A ☐

If any compound fails this criterion, qualify the failed compound in all samples associated with that IC; qualify positive results "J" and non-detects "R".

Are all %RSDs less than 30%? Yes ☐ No ☐ N/A ☐

If any compound fails this criterion, apply qualifiers to that compound in all samples associated with that IC, according to the following guidelines:

Condition	Positives	Non-Detects
30% < %RSD < 50%	"J"	"UJ"
50% ≤ %RSD ≤ 80%	"J"	"UJ"
%RSD > 80%	"J"	"R"

CONTINUING CALIBRATIONS (CCs)

Are all RRFs greater than 0.05? Yes ☐ No ☐ N/A ☐

If any compound fails this criterion, qualify the failed compound in all samples associated with that CC; qualify positive results "J" and non-detects "R".

Are all %Ds less than 25%? Yes ☐ No ☐ N/A ☐

If any compound fails this criterion, apply qualifiers to that compound in all samples associated with that CC, according to the following guidelines:

Condition	Positives	Non-Detects
25% < %D ≤ 80%	"J"	"UJ(-)/No qualifiers(+)"
%D > 80% and the RF from CC > RRF from IC	"J"	"UJ"
%D > 80% and the RF from CC < RRF from IC	"J"	"R"

INTERNAL STANDARDS (ISs)

Are all IS retention times within 30 seconds of the retention times for the ISs in the associated CCs? Yes ☐ No ☐ N/A ☐

If any IS in a sample fails this criterion, qualify all compounds that are quantitated with that IS in that sample; qualify positive results "J" and non-detects "R".

Are all IS area counts > 50% and < 200% of the area count for the ISs in the associated CCs? Yes ☐ No ☐ N/A ☐

If any IS in a sample fails this criterion, qualify all compounds that are quantitated with that IS in that sample, according to the following guidelines:

Condition	Positives	Non-Detects
Sample Count > 200%	"J"	No qualifiers
25% ≤ Sample Count < 50%	"J"	"UJ"
Sample Count < 25%	"J"	"R"

MANUAL INTEGRATION (IF APPLICABLE)

If manual integrations were performed, does the data package include a copy of the chromatogram before and after each manual integration, and the reason for each manual integration? Yes ☐ No ☐ N/A ☐

If manual integrations were preformed and copies of the manual integrations were not provided, qualify the results as unusable "R".

Are manual integrations acceptable?

Yes	No	N/A
☐	☐	☐

Verify that manual integrations are across the base of the peak and no area beyond the peak or below the baseline is included in the integration. Verify that co-eluting peaks and/or unresolved complex mixtures are excluded from manual integration to the extent possible. Qualify incorrect manual integration as follows:

Condition	Positives	Non-Detects
Over-integration	"J"	No qualifiers
Under-integration	"J"	"R"

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FIELD DUPLICATES (IF APPLICABLE)

Are all compounds present in either the sample or duplicate also present in the other?

Yes	No	N/A
☐	☐	☐

Data are not qualified based on field duplicate precision; rather, an overall assessment of whether or not the data is representative of field conditions is made. This assessment should be discussed in the final report. If several compounds are present in either the sample or the duplicate but not in the other, then data may be qualitatively questionable. Some guidelines for evaluation:

- Any sample or duplicate data point that is below the DL is considered to be a positive result if the other data point in the pair is a positive result.
- Any sample or duplicate data point that is below the DL is considered to be a non-detect if the other data point in the pair is a non-detect.
- If several discrepancies are noted, check to see if they are consistent (i.e., always present in the sample, but not detected in the duplicate).
- If discrepancies are consistent, compare DLs to see if there may be a large dilution factor for whichever sample consistently shows the non-detects.

Are all RPDs between sample and duplicate acceptable?

Yes	No	N/A
☐	☐	☐

Make an overall assessment of the quantitative precision of the sample-duplicate data. All RPDs should be generally within 100%. Calculate RPDs according to the following guidelines:

- If both data points for a compound are not detected, or are found below the DL, no calculation is necessary.
- Any data point that is found, but below the DL, can be considered a positive result at the DL for calculation purposes.
- The RPD for two data points is (Difference/Mean)×100.

Prepared By: ______________________________ Date ____________________

VALIDATION OF ORGANIC DATA BY GC ANALYSIS

Lab: ______________________ Date: ______________________

Analysis: ______________________ SDG #: ______________________

HOLDING TIMES

Have all SVOC samples been extracted within holding times? Yes ☐ No ☐ N/A ☐

If any sample fails this criterion, apply qualifiers to all results in the sample, according to the following guidelines:

Condition	Positives	Non-Detects
15 Days ≤ Soil Sampling → Extraction ≤ 28 Days	"J"	"UJ"
Soil Sampling → Extraction > 28 Days	"J"	"R"
8 Days ≤ Water Sampling → Extraction ≤ 14 Days	"J"	"UJ"
Water Sampling → Extraction > 14 Days	"J"	"R"

Have all samples been analyzed within holding times? Yes ☐ No ☐ N/A ☐

If any sample fails this criterion for the VOC fraction, apply qualifiers to all results in the sample according to the following guidelines:

Condition	Positives	Non-Detects
15 Days ≤ VOC Sampling → Analysis ≤ 28 Days	"J"	"UJ"
VOC Sampling → Analysis > 28 Days	"J"	"R"

If any sample fails this criterion for either the SVOC, Pesticide/PCB, or Herbicide fraction, apply qualifiers to all results in the sample, for that fraction, according to the following guidelines:

Condition	Positives	Non-Detects
41 Days ≤ Extraction → Analysis ≤ 80 Days	"J"	"UJ"
Extraction → Analysis > 80 Days	"J"	"R"

SYSTEM MONITORING COMPOUNDS (SURROGATES)

	Yes	No	N/A
Are all surrogate recoveries in all samples within QC limits?	☐	☐	☐

If any surrogate failures are observed in a sample for either the VOC, Pesticide/PCB, or Herbicide fraction, apply qualifiers to all results in the sample, for that fraction, according to the following guidelines:

Condition	Positives	Non-Detects
%R > Upper Limit	"J"	No qualifiers
10% ≤ %R < Lower Limit	"J"	"UJ"
%R < 10%	"J"	"R"

If any surrogate failures are observed in a sample for either the Base/Neutral or Acid fractions, apply qualifiers to all results in the sample, for that fraction, according to the following guidelines:

Condition	Positives	Non-Detects
1 %R out & > 10%	No qualifiers	No qualifiers
2 or more %R out, > Upper Limit	"J"	No qualifiers
2 or more %R out, < Lower Limit and all > 10%	"J"	"UJ"
1 or more %R < 10%	"J"	"R"

QC CHECK SAMPLE (LCS)

	Yes	No	N/A
Are all LCS recoveries within QC limits?	☐	☐	☐

If any LCS compound fails this criterion, apply qualifiers to the failed compound in all samples associated with that LCS, according to the following guidelines:

Condition	Positives	Non-Detects
%R > Upper Limit	"J"	No qualifiers
30% ≤ %R < Lower Limit	"J"	"UJ"
%R < 30%	"J"	"R"

If failures are widespread and consistent in the direction of the failure, then an overall analytical bias can be determined for this fraction.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD)

	Yes	No	N/A
Are all MS/MSD recoveries and relative percent difference (RPD) within QC limits?	☐	☐	☐

MS/MSD data are used in conjunction with LCS data to identify and describe interferences. If LCS recoveries indicate a similar bias, then the bias can be determined to be analytical in nature. If LCS recoveries are in control, then the bias can be identified as a matrix effect.

BLANKS

Are the following free of contamination?	Yes	No	N/A
Method blanks	☐	☐	☐
Trip blanks (if present)	☐	☐	☐
Field/Rinsate blanks (if present)	☐	☐	☐

Use the following steps when qualifying data based on blank contamination.

- Identify all individual data points that are associated with a blank contaminant.
- For any data point associated with contamination from more than one blank, select the blank with the highest concentration of the contaminant. The sample data point will be compared to this contaminant for qualifying purposes.
- Convert the concentration of the selected contaminant to the actual contamination level. Divide the contamination concentration by the blank detection limit and multiply by the sample detection limit.
- Qualify all data points associated with a common laboratory contaminant (acetone, 2-butanone, methylene chloride, or common phthalates) according to the following guidelines:

Condition	**Flag**
No Positive Sample Result	None
Positive Sample Result < 10x Contamination Level	"UJ"
Positive Sample Result > 10x Contamination Level	None

- Qualify all data points associated with any other laboratory contaminant according to the following guidelines:

Condition	Flag
No Positive Sample Result	None
Positive Sample Result < 5x Contamination Level	"UJ"
Positive Sample Result > 5x Contamination Level	None

INITIAL CALIBRATIONS (ICs)

Are all %RSDs within QC limits for the quantitation column? Yes ☐ No ☐ N/A ☐

If any compound fails this criterion, apply qualifiers to that compound in all samples associated with that IC, according to the following guidelines:

Condition	Positives	Non-Detects
25% < %RSD < 50%	"J"	"UJ"
50% ≤ %RSD ≤ 80%	"J"	"UJ"
%RSD > 80%	"J"	"R"

CONTINUING CALIBRATIONS (CCs)

Are all %Ds within QC limits for the quantitation and confirmation columns? Yes ☐ No ☐ N/A ☐

If any compound fails this criterion, apply qualifiers to that compound in all samples associated with that CC, according to the following guidelines:

Condition	Positives	Non-Detects
25% < %D ≤ 80%	"J"	"UJ(-)/No Qualifiers(+)"
%D > 80% and the RF from the CC > RRF from IC	"J"	"UJ"
%D > 80% and the RF from the CC < RRF from IC	"J"	"R"

SECOND COLUMN CONFIRMATIONS

Are retention times of reported target compounds in each sample within retention time windows on both columns?

Yes	No	N/A
☐	☐	☐

If a detected target compound peak is outside the retention time window on one or both columns, replace the result with the reporting limit and qualify the result "UJ".

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Is the target compound RPD between the two gas chromatograph columns within 25.0%?

Yes	No	N/A
☐	☐	☐

If target compounds were detected on both GC columns, and the RPD is greater than 25.0%, consider the potential for coelution and use professional judgment to decide whether a much larger concentration obtained on one column versus the other indicates the presence of an interfering compound. If an interfering compound is indicated, use professional judgment to determine how best to report, and if necessary, qualify the data as follows:

Condition	Qualification
25% < RPD ≤ 50%	"J"
RPD > 50%	"UJ"

MANUAL INTEGRATION (IF APPLICABLE)

If manual integrations were performed, does the data package include a copy of the chromatogram before and after each manual integration, and the reason for each manual integration?

Yes	No	N/A
☐	☐	☐

If manual integrations were preformed and copies of the manual integrations were not provided, qualify the results as unusable "R".

Are manual integrations acceptable?

Verify that manual integrations are across the base of the peak and no area beyond the peak or below the baseline is included in the integration. Verify that co-eluting peaks and/or unresolved complex mixtures are excluded from manual integration to the extent possible. Qualify incorrect manual integration as follows:

Condition	Positives	Non-Detects
Over-integration	"J"	No qualifiers
Under-integration	"J"	"R"

FIELD DUPLICATES (IF APPLICABLE)

Are all compounds present in either the sample or duplicate also present in the other? Yes ☐ No ☐ N/A ☐

Data are not qualified based on field duplicate precision; rather, an overall assessment of whether or not the data is representative of field conditions is made. This assessment should be discussed in the final report. If several compounds are present in either the sample or the duplicate but not in the other, then data may be qualitatively questionable. Some guidelines for evaluation:

- Any sample or duplicate data point that is below the DL is considered to be a positive result if the other data point in the pair is a positive result.
- Any sample or duplicate data point that is below the DL is considered to be a non-detect if the other data point in the pair is a non-detect.
- If several discrepancies are noted, check to see if they are consistent (i.e., always present in the sample, but not detected in the duplicate).
- If discrepancies are consistent, compare DLs to see if there may be a large dilution factor for whichever sample consistently shows the non-detects.

Are all RPDs between sample and duplicate acceptable? Yes ☐ No ☐ N/A ☐

Make an overall assessment of the quantitative precision of the sample-duplicate data. All RPDs should be generally within 100%. Calculate RPDs according to the following guidelines:

- If both data points for a compound are not detected, or are found below the DL, no calculation is necessary.
- Any data point that is found, but below the DL, can be considered a positive result at the DL for calculation purposes.
- The RPD for two data points is (Difference/Mean)x100.

Prepared By: ______________________ Date ______________

VALIDATION OF RADIOCHEMISTRY DATA

Lab: ______________________ Date: ______________________

Analysis: ______________________ SDG #: ______________________

HOLDING TIMES

	Yes	No	N/A
Have all samples been analyzed within 180 days?	☐	☐	☐

If any sample fails this criterion, apply "J" qualifier to all sample results.

LABORATORY CONTROL SAMPLE (LCS)

	Yes	No	N/A
Are all LCS recoveries within QC limits?	☐	☐	☐

Gross Alpha, Beta: Recovery = ± 30%
All others: Recovery = ± 25%

If any LCS compound fails this criterion, apply qualifiers to the failed compound in all samples associated with that LCS, according to the following guidelines:

Condition	Positives	Non-Detects
Gross Alpha, Beta: ± 30% < %R ≤ ± 90%	"J"	"UJ"
%R > ± 90%	"J"	"R"
All others: ± 25% < %R ≤ ± 75%	"J"	"UJ"
%R > ± 75%	"J"	"R"

Out of acceptance criteria comments:

MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD)

Are all MS/MSD recoveries within QC limits? Yes ☐ No ☐ N/A ☐

Gross Alpha, Beta: Recovery = ± 30%
All others: Recovery = ± 25%
(Except when sample concentration > 4x spike concentration)

Review MS recoveries and apply qualifiers to failed compounds in all associated samples.

Condition	Positives	Non-Detects
Gross Alpha, Beta: ± 30% < %R ≤ ± 90%	"J"	"UJ"
%R > ± 90%	"J"	"R"
All others: ± 25% < %R ≤ ± 75%	"J"	"UJ"
%R > ± 75%	"J"	"R"

Are all MS/MSD RPD within QC limits? Yes ☐ No ☐ N/A ☐

Gross Alpha, Beta: RPD = ± 30%
All others: RPD = ± 25%

Out of acceptance criteria comments:

BLANKS

	Yes	No	N/A
Are all Reagent Blank results below Reporting Limits?	☐	☐	☐
Are Field/Rinsate Blanks, if present, below Reporting Limits?	☐	☐	☐

If the blank results fall outside the appropriate limits, qualify the results for all associated samples that are less than 10 times the blank value as estimated, "J" or "UJ"

Out of acceptance criteria comments:

CALIBRATIONS

	Yes	No	N/A
Are Continuing Calibrations within acceptable limits?	☐	☐	☐

Check Calibration QC information for each type of counter.

Gross Proportional Counter: Gross Alpha/Beta, Strontium-90
Gamma Spectroscopy
Liquid Scintillation Counter: Carbon-14, Tritium
Lucas Cell Counter: Radium-226

Check trends for HI and LOW flags. If any detector FAILED, check run logs to make sure no samples were counted on that day for a failed detector.

The LSC calibration sheet needs further explanation as to action limits. Until further clarification, make sure that H-3 and C-14 COR/AVG % Diff columns are < 1.0.

Out of acceptance criteria comments:

LAB DUPLICATES

	Yes	No	N/A
Is the RER (Replicate Error Ratio) ≤1.0?	☐	☐	☐

If RER for a particular radionuclide is greater than 1, qualify the results for that radionuclide in all associated samples of the same matrix as estimated, "J."

$$RER = |S - D| / (2\sigma_S + 2\sigma_D)$$

Where S = Original sample value
D = Duplicate sample value
$2\sigma_S$ = Original sample uncertainty
$2\sigma_D$ = Duplicate sample uncertainty

Out of acceptance criteria comments:

FIELD DUPLICATES (IF APPLICABLE)

Do field duplicate values generally look similar?

Yes	No	N/A
☐	☐	☐

Field duplicate samples may be taken and analyzed as an indication of overall precision. These analyses measure both field and lab precision; therefore, the results may have more variability than lab duplicates that measure only lab performance. It is expected that soil duplicate results will have a greater variance than water matrices due to difficulties associated with collecting identical field samples. Any evaluation of field duplicates shall be provided with the reviewer's comments.

Field Duplicate comments:

COMMENTS:

Prepared By: ______________________________ Date ____________________

VALIDATION OF METALS DATA

Lab: ______________________ Date: ______________________

Analysis: ______________________ SDG #: ______________________

HOLDING TIMES

Have all samples been analyzed within holding times? Yes ☐ No ☐ N/A ☐

28 Days for Mercury
180 Days for all other Metals

If any sample fails this criterion, apply qualifiers to all results in the sample according to the following guidelines:

Condition	Positives	Non-Detects
Mercury held 29-56 days	"J"	"UJ"
Mercury held > 56 days	"J"	"R"
Other metals held 181-360 days	"J"	"UJ"
Other metals held > 360 days	"J"	"R"

Out of acceptance criteria comments:

LABORATORY CONTROL SAMPLE (LCS)

Are all LCS recoveries within QC limits? Yes ☐ No ☐ N/A ☐

Water: %R should be between 80%-120%.
Soils: "Found" should be between the limits provided on Form 7 (65%-135% for solid LCS).

If any LCS compound fails this criterion (except for Silver or Antimony in water), apply qualifiers to the failed compound in all samples associated with that LCS, according to the following guidelines:

Condition		Positives	Non-Detects
Water:	%R > 120%	"J"	No Qualifiers
	50% ≤ %R < 80%	"J"	"UJ"
	%R < 50%	"J"	"R"
Soil:	%R > Upper Limit	"J"	No Qualifiers
	30% ≤ %R < Lower Limit	"J"	"UJ"
	%R < 30%	"J"	"R"

If failures are widespread and consistent in the direction of the failure, than an overall analytical bias can be determined for this fraction.

Out of acceptance criteria comments:

BLANKS

Are the following free of contamination?	Yes	No	N/A
Preparation Blanks	☐	☐	☐
Initial Calibration Blanks	☐	☐	☐
Continuing Calibration Blanks	☐	☐	☐
Field/Rinsate Blanks (if present)	☐	☐	☐

Use the following steps when qualifying data based on blank contamination.

- List all calibration blank contaminants, but do not flag data.
- Identify all individual data points that are associated with preparation blank contaminant.
- For any data point associated with contamination from more than one preparation blank, select the blank with the highest concentration of the contaminant. The sample data point will be compared to this contaminant for qualifying purposes.
- Convert the concentration of the selected contaminant to the actual contamination level. Divide the contamination concentration by the blank detection limit and multiply by the sample detection limit.
- Qualify all data points associated with a laboratory contaminant according to the following guidelines:

Condition	Qualifier
No Positive Sample Result	None
Positive Sample Result < 5x Contamination Level	"UJ"
Positive Sample Result > 5x Contamination Level	None

Out of acceptance criteria comments:

LAB DUPLICATES

Are all RPDs between the sample and duplicate acceptable? Yes ☐ No ☐ N/A ☐

If the sample values are ≥ 5x the CRDL, the RPDs for original and duplicate sample values should be within 20% (35% for soil).

If sample values are ≤ 5x the CRDL, the RPD should be ± the CRDL.

For Metals, the duplicate is usually run on the matrix spike sample.

Out of acceptance criteria comments:

MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) AND POST DIGESTION SPIKE

Are all MS/MSD recoveries within 75%-125%?
(Except when sample concentration > 4x spike concentration) Yes ☐ No ☐ N/A ☐

MS/MSD data are used in conjunction with LCS data to identify and describe interferences. If LCS and MS/MSD recoveries indicate a similar bias, then the bias can be determined to be analytical in nature. If LCS recoveries are in control, then the bias can be identified as a matrix effect. A post-digestion spike (PDS) may be performed when spiked metals do not meet matrix spike control limits.

Condition	Positives	Non-Detects
MS %R > 125%	"J"	No Qualifiers
MS %R < 75% and ≥ 30%	"J"	"UJ"
MS %R < 30% (10% for Antimony), no PDS or PDS %R < 75%	"J"	"R"
MS %R < 30% (10% for Antimony), PDS %R ≥ 75%	"J"	"UJ"

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Out of acceptance criteria comments:

INDUCTIVELY COUPLED PLASMA (ICP) - INTERFERENCE CHECK SAMPLE (ICS)

Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) and Inductively Coupled Plasma -Mass Spectrometry (ICP-MS)

Are ICS recoveries within 80%-120%?

Yes ☐ No ☐ N/A ☐

If any ICS analyte fails this criterion, apply qualifiers to the failed analyte in all samples associated with that ICS, according to the following guidelines:

Condition	Positives	Non-Detects
ICP-AES: ICS %R > 120% (or > true value + CRQL)	"J"	No Qualifiers
50% ≤ %R < 80% (or < true value - CRQL)	"J"	"UJ"
%R < 50%	"J"	"R"
ICP-MS: ICS %R > 120% (or > true value + 2 x CRQL)	"J"	No Qualifiers
50% ≤ %R < 80% (or < true value – 2 x CRQL)	"J"	"UJ"
%R < 50%	"R"	"R"

Out of acceptance criteria comments:

INDUCTIVELY COUPLED PLASMA (ICP) – SERIAL DILUTIONS

Are serial dilution percent differences (%D) ≤ 10%?

Yes ☐ No ☐ N/A ☐

Serial dilution is applicable to analytes with concentrations greater than 50 times (50x) the Method Detection Limit (MDL) in the original (undiluted) sample. If a serial dilution %D exceeds 10%, apply qualifiers to the failed analyte in the sample (and chemically similar samples within the same quality control batch) according to the following guidelines:

Condition	Positives	Non-Detects
Sample concentration > 50x MDL and %D > 10	"J"	"UJ"

Out of acceptance criteria comments:

CALIBRATIONS

	Yes	No	N/A
Are all ICV recoveries within QC limits:	☐	☐	☐

Mercury:	%R between 80%-120%
All other Metals:	%R between 90%-110%

If any compound fails this criterion, qualify positive results for the failed compound “J” and qualify non-detects for the failed compound “UJ” in all samples associated with that ICV.

	Yes	No	N/A
Are all CCV recoveries within QC limits:	☐	☐	☐

Mercury:	%R between 80%-120%
All other Metals:	%R between 90%-110%

If any compound fails this criterion, qualify positive results for the failed compound “J” and qualify non-detects for the failed compound “UJ” in all samples associated with that CCV.

Out of acceptance criteria comments:

FIELD DUPLICATES (IF APPLICABLE)

	Yes	No	N/A
Are all compounds present in either the sample or duplicate also present in the other?	☐	☐	☐

Data are not qualified based on field duplicate precision; rather, an overall assessment of whether or not the data is representative of field conditions is made. This assessment should be discussed in the final report. If several compounds are present in either the sample or the duplicate but not in the other, then data may be qualitatively questionable. Some guidelines for evaluation:

- Any sample or duplicate data point that is below the DL is considered to be a positive result if the other dat point in the pair is a positive result.
- Any sample or duplicate data point that is below the DL is considered to be non-detect if the other data point in the pair is a non-detect.
- If several discrepancies are noted, check to see if they are consistent (i.e., always present in the sample, but not detected in the duplicate).
- If discrepancies are consistent, compare DLs to see if there may be a large dilution factor for whichever sample consistently shows the non-detects.

Are all RPDs between sample and duplicate acceptable?

Yes	No	N/A
☐	☐	☐

Make an overall assessment of the quantitative precision of the sample-duplicate data. All RPDs should be generally within 100%. Calculate RPDs according to the following guidelines:

- If both data points for a compound are not detected, or found below the DL, no calculation is necessary.
- Any data point that is found, but below the DL, can be considered a positive result at the DL for calculation purposes.
- The RPD for two data points is (Difference/Mean)x100.

Out of acceptance criteria comments:

Prepared By: ______________________________ Date ____________________

VALIDATION OF DATA FROM WET CHEMISTRY OR OTHER MISCELLANEOUS ANALYSES

Lab: ______________________ Date: ______________________

Analysis: ______________________ SDG #: ______________________

HOLDING TIMES

Have all samples been analyzed for all compounds within holding times? Yes ☐ No ☐ N/A ☐

If any sample fails this criterion, apply qualifiers to all results in the sample according to the following guidelines:

Condition	Positives	Non-Detects
HT + 1 ≤ Analysis ≤ 2 x HT	"J"	"UJ"
Anaylsis > 2 x HT	"J"	"R"

LABORATORY CONTROL SAMPLE (LCS)

Are all LCS recoveries within QC Limits? Yes ☐ No ☐ N/A ☐

If any compound fails this criterion, apply qualifiers to the failed compound in all samples associated with that LCS, according to the following guidelines:

Condition	Positives	Non-Detects
%R > Upper Limit	"J"	No Qualifiers
30% ≤ %R < Lower Limit	"J"	"UJ"
%R < 30%	"J"	"R"

If failures are widespread and consistent in the direction of the failure, then an overall analytical bias can be determined for this fraction.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD)

	Yes	No	N/A
Are all MS/MSD recoveries within QC limits?	☐	☐	☐

MS/MSD data are used in conjunction with LCS data to identify and describe interferences. If LCS recoveries indicate a similar bias, then the bias can be determined to be analytical in nature. If LCS recoveries are in control, then the bias can be identified as a matrix effect.

BLANKS

Are the following free of contamination?	Yes	No	N/A
Laboratory Blanks	☐	☐	☐
Trip Blanks (if present)	☐	☐	☐
Field/Rinsate Blanks (if present)	☐	☐	☐

Use the following steps when qualifying data based on blank contamination.

- Identify all individual data points that are associated with a blank contaminant.
- For any data point associated with contamination from more than one blank, select the blank with the highest concentration of the contaminant. The sample data point will be compared to this contaminant for qualifying purposes.
- Convert the concentration of the selected contaminant to the actual contamination level. Divide the contamination concentration by the blank detection limit and multiply by the sample detection limit.
- Qualify all data points associated with a laboratory contaminant according to the following guidelines:

Condition	**Qualifier**
No Positive Sample Result	None
Positive Sample Result < 5x Contamination Level	"UJ"
Positive Sample Result > 5x Contamination Level	None

CALIBRATIONS

	Yes	No	N/A
Are all initial calibrations acceptable?			
%RSDs within QC limits? (If applicable)	☐	☐	☐
Correlation coefficients > 0.995? (If applicable)	☐	☐	☐
ICV recoveries within QC limits? (If applicable)	☐	☐	☐

If any compound fails applicable criterion, as specified in the QAPjP and/or the method, qualify positive results for the failed compound "J" and non-detects for the failed compound "UJ" in all samples associated with that ICV.

	Yes	No	N/A
Are all continuing calibrations acceptable?			
%Ds within QC limits? (If applicable)	☐	☐	☐
CCV recoveries within QC limits? (If applicable)	☐	☐	☐

If any compound fails applicable criterion, as specified in the QAPjP and/or the method, qualify positive results for the failed compound "J" and non-detects for the failed compound "UJ" in all samples associated with that CCV.

FIELD DUPLICATES (IF APPLICABLE)

	Yes	No	N/A
Are all compounds present in either the sample or duplicate also present in the other?	☐	☐	☐

Data are not qualified based on field duplicate precision; rather, an overall assessment of whether or not the data is representative of field conditions is made. This assessment should be discussed in the final report. If several compounds are present in either the sample or the duplicate, but not in the other, then data may be qualitatively questionable. Some guidelines for evaluation:

- Any sample or duplicate data point that is below the DL is considered to be a positive result if the other data point in the pair is a positive result.
- Any sample or duplicate data point that is below the DL is considered to be a non-detect if the other data point in the pair is a non-detect.
- If several discrepancies are noted, check to see if they are consistent (i.e., always present in the sample, but not detected in the duplicate).
- If discrepancies are consistent, compare DLs to see if there may be a large dilution factor for whichever sample consistently shows the non-detects.

Are all RPDs between sample and duplicate acceptable?

Yes	No	N/A
☐	☐	☐

Make an overall assessment of qualitatively precision of the sample duplicate data. All RPDs should be generally within 100%. Calculate RPDs according to the following guidelines:

- If both data points for a compound are not detected, or found below the DL, no calculation is necessary.
- Any data point that is found, but below the DL, can be considered a positive result at the DL for calculation purposes.
- The RPD for two data points is (Difference/Mean)x100.

Prepared By: ______________________________ Date ____________________

ATTACHMENT 6.2

DATA VALIDATION QUALIFIER DEFINITIONS

DATA VALIDATION QUALIFIER DEFINITIONS

The following definitions provide brief explanations of the data validation qualifiers assigned to results in the data review process.

Flag	Data Qualifier Definition
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

DATA VALIDATION REASON CODE DESCRIPTIONS

The following descriptions provide brief explanation of the cause for qualification of the results determined in the data review process. These reason codes are used in combination with the data qualifier, i.e. “Uz” indicates the analyte is non-detect due to method blank contamination.

Flag	Reason Code Description
c	Calibration failure; poor or unstable response.
d	Matrix duplicate imprecision or matrix spike/matrix spike duplicate imprecision.
f	Field replicate or duplicate imprecision.
h	Holding time violation.
i	Internal standard failure.
k	Serial dilution imprecision.
l	Laboratory control sample (LCS) recovery failure.
m	Matrix spike/matrix spike duplicate (MS/MSD) recovery failure.
n	Interference check sample recovery failure.
q	Below CRQL/CRDL or above calibration range.
s	Surrogate spike recovery failure.
v	Detected concentrations > 25% difference between 2 GC columns (Pesticides).
z	Blank contamination.

LEHR DATA VALIDATION SUMMARY

Project: Project Number:

Analyses: Lab ID:

Sample ID:

Comments:

Flags:

Compound	Sample/Group ID	Detects	Non-Detects	Comments

Reviewed by: ______________________________ Date: ____________

SAMPLE DATA MANAGEMENT

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for electronic data management. Consistent procedures for data acquisition, entry and verification must be followed to ensure that electronic data are accurate and dependable. Additional specific procedures and requirements will be provided in the project work plans.

2.0 REFERENCES

2.1 SQP 4.2 - Records Management

2.2 SOP 21.1 – Data Validation

3.0 DEFINITIONS

3.1 Data Validation

Electronic data management is a system for managing project data from the planning phase, through collection, assembly, database import, data quality verification, and export for data use. During the data management process, all data collection, database import and export are planned and managed to control and maintain data integrity and usefulness.

3.2 Electronic Data Deliverable (EDD)

Computer file containing delimited data that can be loaded into a database for management in tabular form.

4.0 PROCEDURE

This section contains both the responsibilities and procedures involved with electronic data management.

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that all electronic data management activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

4.1.2 The Project Manager is responsible for ensuring electronic data management tasks are completed according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the database manager and PQAM.

4.1.3 The Project QA Manager (PQAM) is responsible for periodic review of documentation associated with this electronic data management SOP. The PQAM is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to electronic data management requirements, issuing nonconformances, etc.) if problems occur.

4.2 Electronic Data Management

4.2.1 Sample data shall be stored and managed in a relational database. Only qualified staff will be allowed use of the database. The database manager will annually inspect the operating system and software procured for the project and determine whether the configuration is acceptable to support the database.

An electronic data deliverable (EDD) will be issued by the laboratory for each laboratory report. The EDD format will consist of a flat file delivered in Microsoft Excel spreadsheet files, text files with delimited format, or equivalent. At a minimum, the laboratory EDDs will contain the following fields of information:

- Laboratory sample identifier
- Sample delivery group
- Date laboratory report was issued
- Date the data were approved by the laboratory
- Sample type
- Sample identifier as written on chain-of-custody
- Sample collection date
- Sample collection time

- Sample preparation date
- Sample preparation time
- Date sample was received by the laboratory
- Time sample was received by the laboratory
- Date sample was tested by the laboratory
- Time sample was tested by the laboratory
- Code indicating the sample is a dissolved fraction, extract or total
- Analysis method reference
- Code indicating the result is a field duplicate, laboratory duplicate, spike, blank or primary sample
- Flag indicating whether the result is a surrogate compound
- Laboratory quality control batch identifier
- Dilution
- Laboratory name for the chemical, radionuclide or parameter under analysis
- Chemical abstract system number for the analyte
- Quantitative result
- Counting error for radionuclide results
- Units of the result
- Flag indicating whether the analyte was detected
- Laboratory data qualifier
- Detection limit (reporting limit)
- Method detection limit
- Percent recovery of spiked sample
- Spiked concentration

- Relative percent difference

Upon completion of data validation (SOP 21.1), the Project Chemist will complete a Data Reporting Form (Section 6.1) containing data import instructions and attached copies of the data qualification summary, laboratory certificates of analysis, and chain of custody forms. The database manager will load the EDD into a temporary database table, enter the data qualifiers and qualification reason codes and sample collection information from the chain-of-custody and field data forms.

The Project Chemist or designee (not the database manager) will verify the electronic data before entry into the permanent database. Laboratory data validation and field data verification will be complete before starting the data import process. The electronic data verification tasks are:

- Obtain the laboratory report and data validation report from the Project Chemist.
- Obtain a copy of the validated and verified field data from the Project Manager.
- Obtain a printout of the temporary data from the database manager.
- Compare the certificate of analysis to the database printout. At a minimum, compare the sample identifier, sample collection date, laboratory test date, parameter name, result, detection limit, counting error (radionuclides only) and units.
- Compare the field data to the database printout. Compare the sample identifier, sample collection date, sample type, sample depth (if soil), filtration, coordinates, etc. as appropriate.
- Compare the validation qualifiers from the data validation report to the expert review qualifiers on the database printout.
- If data on the database printout do not agree with the validated field or laboratory data, record the corrections on the printout. Submit corrected printout to the database manager.

The database manager will enter the corrections in the database and re-issue a corrected copy to the reviewer. The verification process is complete when the reviewer finds no discrepancies between the electronic data and the validated field and laboratory data. The data reviewer initials and dates the final quality control check entries on the Data Reporting Form.

Upon obtaining reviewer approval the database manager will move the data into the permanent database. The database manager will ensure that data qualifications are included with all data output from the project database. The PQAM or designee will ensure that data qualifications and explanations of the qualifiers are included in all reports that present the data.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record file in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Data Reporting Form

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

DATA REPORTING FORM

DATA REPORTING FORM

EDD File Location and Name:

Comments:

☐ Enter data qualifiers and reason codes shown on Data Validation Summary sheet.

☐ No Qualifications.

QC Level:

☐ Level II

☐ Level IV

Requested by: ______ Date of Request: ______________

Date Due: ______________

EDD appended to database by: ______________ Date of Import: _________________

Final QC Check by:________________________ Date of QC Check: _______________

LAND SURVEYING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This standard operating procedure (SOP) describes the methods for obtaining information through field surveys, property surveys, and surveys of monitoring wells. In performing these methods, other survey requirements may need to be fulfilled (e.g., monument construction, boundary surveys). Surveying and mapping methods include plane table and alidade mapping, transit-stadia mapping, three-wire trigonometric leveling, and electronic distance measurement.

2.0 REFERENCES

2.1 SQP 4.2 - Records Management

2.2 U.S. Coast and Geodetic Survey (1960), Hydrographic Manual, Karl B. Jeffers, U.S. Government Printing Office

3.0 DEFINITIONS

The location of points and orientation of lines frequently depends upon measurement of angles and directions. Directions are given by bearings and azimuths.

3.1 Azimuth

Azimuths are horizontal angles measured clockwise from any reference meridian. It is necessary to state in the field notes, at the beginning of the work, what the reference meridian is and whether azimuths are measured from north or south.

3.2 Bearing

Bearings represent one system of designating directions of lines. The bearing of a line is the acute horizontal angle between a reference meridian and the line. The angle is measured from either the north or south, toward the east or west, to give a reading less than 90^o.

3.3 Bench Mark

A relatively permanent object, natural or artificial, bearing a marked point whose elevation above or below an adapted datum is known or assumed.

3.4 Second (")

One 1/60th part of a minute of angular measurement.

3.5 Third-Order Plane Survey

The required accuracy for a control survey depends on its purpose, and classification standards for accuracy have been developed by the Federal Geodetic Control Committee. There are three orders of accuracy; in descending order as first-order, second-order, and third-order. Third-order vertical control survey relative accuracy is 2.0 mm x $\sqrt{K}$, where K is the distance between bench marks in kilometers. Third order horizontal central survey relative accuracy is 1 part in 10,000 (Class I) or 1 part in 5,000 (Class II). Survey requirements normally necessitate survey accuracy of the third order; however, the second order may be required at some sites. For the majority of sites, surveys, unless otherwise specified, will be third-order plane surveys as defined in Table 1. Work plans will specify the required accuracy for individual projects.

3.6 Transit

A surveying instrument used for accurate measurement or layout of horizontal and vertical angle, determining horizontal and vertical distances by stadia, prolonging straight lines and low-order differential leveling. A transit may also be known as a theodolite.

3.7 Traverse

A traverse is a series of consecutive lines whose lengths and directions have been determined from field measurements. Traversing, the act of establishing traverse stations and making required measurements, is one of the most common means of determining the relative locations of points.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Project Manager is responsible for ensuring that the surveying is properly performed. This will be accomplished through staff training or verifying the qualifications of survey subcontractors, and by maintaining quality assurance/quality control (QA/QC).

4.1.2 As a minimum, project management is responsible for seeing that the field personnel or survey team receive the following:

- Review of site specific work plans, which address this procedure (e.g., sampling and analysis plans, quality assurance plans, etc.).
- Review of this SOP and associated SOPs listed in this section.
- Training in the proper land surveying technique and equipment to be used.

4.1.3 The Project Quality Assurance Manager (PQAM) is responsible for the periodic review of documentation generated by the performance of this procedure. The PQAM may also perform audits and surveillances of field personnel or survey team as they perform land surveys to assure compliance with specified procedures.

4.1.4 Field Personnel or Survey Crew - Field personnel or the Survey Team are responsible for conducting the land survey activities in accordance with acceptable industry standards and this SOP, and for the proper documentation of these activities and resulting measurements.

4.2 Procedures

4.2.1 Third-order plane surveys and horizontal angular measurements should be made with a 20-second or better transit. Angles should be doubled, and the mean of the doubled angle should be within 10 seconds of the first angle. Distance measurements will be made with a calibrated tape corrected for temperature and tension or with a calibrated electronic distance meter instrument (EDMI). When using EDMI, the manufacturer's offset, curvature and refraction corrections should be applied as directed by the instrument operating instructions.

4.2.2 Third-Order Vertical Survey - Land surveys are to be completed by a surveyor who is licensed and registered in the state where the survey is conducted. When practical, vertical control will be referenced to the National Geodetic Vertical Datum (NGVD) of 1929, obtained from a permanent bench mark. If possible, level circuits will close on a bench mark whose elevation is known (other than the starting bench mark). If the circuit closes on the original bench mark, the last point in the circuit will be used as a turning point. The following criteria will be met when conducting the survey:

- Rod levels will be used.
- Foresight and backsight distances will be reasonably balanced.
- No side shot will be used as a turning point in any level loop.
- Elevation readings will be recorded to 0.01 foot and estimated to 0.005 foot using a calibrated rod.

4.2.3 Temporary monuments will be set and referenced for future recovery. All monuments will be described in the field notes and consist of a permanent mark scribed on facilities such as sidewalks, paved roads, or curbs. Sufficient description will be provided to facilitate their recovery.

4.2.4 Property Surveys - All property surveys will be performed in accordance with good land surveying practices and conform to all pertinent federal and state laws and regulations governing land surveying in the area where the work is being accomplished.

4.2.5 Upon completion of the project, all original field notebooks, computations, and pertinent reference materials will be delivered to the Project Manager for retention in the project record files. The surveyor may keep photostatic copies of the material. All field note reductions will be checked and marked. All office entries in field notebooks will be made in a pen color different than the original.

4.2.6 Traverse Computations and Adjustments - Traverses will be closed and adjusted in the following manner:

- Bearing closures will be computed and adjusted if within limits defined in applicable work plans.
- Coordinate closures will be computed using adjusted bearings and unadjusted field distances.
- Coordinate positions will be adjusted if the traverse closes within the specified limits. The method of adjusting shall be determined by the surveyor.
- Final adjusted coordinates will be labeled as "adjusted coordinates." Field coordinates should be specifically identified as such.
- The direction and length of the unadjusted error of closure, the ratio of error over traverse length, and the method of adjustment should be printed with the final adjusted coordinates.

4.2.7 Level Circuit Computations and Adjustments - Level circuits will be closed and adjusted in the following manner:

- For a single circuit, elevations will be adjusted proportionally, provided the raw closure is within the prescribed limits for that circuit.
- In a level net where the elevation of a point is established by more than one circuit, the method of adjustment should consider the length of each circuit, the closure of each circuit, and the combined effect of all the separate circuit closures on the total net adjustment.

4.2.8 Monitoring Well Surveys - Monitoring well locations are surveyed only after the installation of the tamper proof locking cap well casing cover, which is set in concrete. The horizontal plane survey accuracy is ±1 foot (unless greater accuracy is required) and is measured to any point on the well casing cover. The vertical plane survey must be accurate to ±0.01 foot. Three elevations are measured, including the following:

- Top of the inner well casing (on the lip).
- Top of the outer protective casing (on the lip, not the cap).
- Survey monument on the finished concrete pad adjacent to the outer well casing.

4.2.9 The point on the casing where the elevation is to be measured will be scribed or notched so that water level measurements may be taken at the same location.

Note: The Project Manager should ensure that the surveying party is given the keys to the locks before starting the survey.

4.3 Hydrographic Surveys

4.3.1 Hydrographic surveys deal with the measurement and definition of the configuration of the bottom and adjacent land areas of oceans, lakes, rivers, harbors, and other bodies of water.

4.3.2 The size of the body of water will dictate the type of survey required to perform the necessary mapping. Surveys should conform to the requirements set forth in this SOP and in the "Hydrographic Manual" by the U.S. Coast and Geodetic Survey (1960).

4.3.3 Mark sampling locations or survey points with wooden lathe stakes, wooden survey pegs or metal fenceposts. Write the location ID on the marker or survey flagging so that it is readily visible. Mark ground water monitoring wells on the guard pipe and inside the casing cap. Use a black marker for wooden stakes, flagging, and the casing cap. Mark the guard pipes with welds or stencils and paint.

5.0 RECORDS

Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Table 1. Standards for Third-Order Plane Surveys

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

STANDARDS FOR THIRD-ORDER PLANE SURVEYS

ATTACHMENT 6.1

TABLE 1

STANDARDS FOR THIRD-ORDER PLANE SURVEYS

Principal Use:

Small engineering projects and small-scale topographic mapping.

TRAVERSE	
Number of bearing courses between azimuth checks	30 to 30 [30]*
Astronomical bearings: standard error of results	8".0 [6".0]*
Azimuth closure at azimuth checkpoint not to exceed (use the smaller value)	30"√N or 8".0 per [20"√N]*
Standard error of the mean for length measurements	1 in 30,000 [1 in 20,000]*
Position closure per loop in feet after azimuth adjustment	1:5,000 checkpoint or 3.34√M, whichever is smaller
Leveling	0.05√M
Levels of error of closure per loop in feet	

*Figures in brackets are commonly used in preparing specification for bid.

N = the number of stations for carrying bearing

M = the distance in miles

RADIOLOGICAL AREAS AND POSTING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes radiological areas and the posting and labeling requirements for environmental restoration and waste management activities at LEHR.

2.0 REFERENCES

2.1 10 CFR 835, "Radiation Protection for Occupational Workers"

3.0 DEFINITIONS

3.1 Airborne Radioactivity Area

Any area accessible to individuals, where:

(1) The concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed the derived air concentration (DAC) values listed in Appendix A or Appendix C of 10 CFR 835; or,

(2) An individual present in the area without respiratory protection could receive an intake exceeding 12 DAC-hours in a week.

3.2 Contamination Area

Any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed the removable surface contamination values specified in Appendix D of this part, but do not exceed 100 times those values.

3.3 High Contamination Area

Any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed 100 times the removable surface contamination values specified in Appendix D of 10 CFR 835.

3.4 Fixed Contamination Area

Any area that contains radioactive material that cannot be readily removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or laundering, in excess of levels in Appendix D of 10 CFR 835.

3.5 Controlled Area

Any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material.

3.6 Radiological Buffer Area

An area established inside of the Controlled Area boundary surrounding Contamination Areas, Airborne Radioactivity Areas, and High Radiation Areas, to provide a secondary boundary to minimize the spread of contamination.

3.7 Derived Air Concentration (DAC)

The values obtained by dividing the Annual Limit on Intake by the volume of air breathed by an average worker during a working year of 2000 hours (i.e., 2.4E3 m^3). These values are shown in Appendix A, 10 CFR 835 (Reference 2.1).

3.8 Very High Radiation Area

Any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in one hour at 1 meter from a radiation source or from any surface that the radiation penetrates.

3.9 High Radiation Area

Any area where an individual can receive a dose equivalent of greater than 100 mrem in one hour at a distance of 30 cm from the radiation source or from any surface through which the radiation penetrates.

3.10 Radiation Area

Any area where an individual can receive a dose equivalent greater than 5 mrem in one hour at a distance of 30 cm from the radiation source or from any surface through which the radiation penetrates.

3.11 Radioactive Material Area

Any area to within a controlled area, accessible to individuals, in which items or containers of radioactive material exist and the total activity of radioactive material exceeds the applicable values provided in Appendix E of 10CFR835.

3.12 Underground Radioactive Material Areas

Any underground items that contain radioactive materials (i.e., pipelines, radioactive cribs, covered ponds, covered ditches, catch tanks inactive burial grounds, and sites of known covered, unplanned releases (spills) etc.).

3.13 Radiological Areas

Areas controlled for radiation protection purposes that are contained within a controlled area, specifically Airborne Radioactivity Areas, Radioactive Material Areas, Radiation Areas, High Radiation Areas, Very High Radiation Areas, Contamination Areas, or Very High Contamination Areas.

4.0 RESPONSIBILITIES

4.1 Project Manager (PM)

The PM is responsible for the safe and effective implementation of this procedure.

4.2 Radiation Safety Officer (RSO)

The RSO is responsible for ensuring that all Radiological Control Technicians and project personnel are trained on this procedure and understand its requirements. The RSO is responsible for implementing this procedure, direct supervision of the Radiation Control Technicians (RCTs), and auditing the work areas for compliance with this procedure.

4.3 Radiological Control Technicians (RCTs)

The RCTs are responsible for assessing radiological areas and placing and removing postings.

5.0 SAFETY PRECAUTIONS/PREREQUISITES

- RCTs posting areas shall have approved signs, tags, and boundary tape available on-site.
- Written authorizations shall be required to control entry into and perform work within radiological areas. Therefore, Hazardous Work Permits (HWP's) shall be utilized when performing any work in radiological areas.

6.0 PROCEDURE

6.1 Posted Areas

The following areas and each access point to a radiological area shall be posted with conspicuous signs bearing the wording and entry requirements in Section 6.2 and if not otherwise exempted in 10 CFR 835:

- Controlled Areas
- Radiological Buffer Areas
- Radiation Areas
- High Radiation Areas
- Very High Radiation Areas
- Airborne Radioactivity Areas
- Contamination Areas
- High Contamination Areas
- Fixed Contamination Areas
- Radioactive Material Areas
- Underground Radioactive Material Areas

6.2 Posting and Entry Requirements

Personnel entry control shall be maintained for each radiological area.

6.2.1 Controlled Areas - Each access point to a Controlled Area shall be posted.

Minimum that shall be required:

- General Employee Radiological Training (GERT) - worker
- Radiological Orientation or Escort Required for Access – visitor

The sign should contain wording equivalent to “Controlled Area”.

6.2.2 Radiological Buffer Areas - Should be established within a Controlled Area to provide secondary boundaries to minimize the spread of contamination in conjunction with work in Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas. Access to these areas should be posted with the words "Caution, Radiological Buffer Area."

Minimum that shall be required:

- General Employee Radiological Training (GERT) - worker
- Radiological Worker I (RW-I)

6.2.3 Radiation Areas - Any area accessible to individuals shall be posted with the words "Caution, Radiation Area."

Minimum that shall be required:

- General Employee Radiological Training (GERT) - worker
- Radiological Worker II (RW-II) Training, TLD, and HWP.

If more than one radiological condition exists in the same area, each condition shall be identified.

6.2.4 High Radiation Areas - Any area accessible to individuals shall be posted with the words "Danger, High Radiation Area." A HWP is required for entry.

Minimum that shall be required:

- General Employee Radiological Training (GERT) – worker (unless RW-II, or above, trained);
- Radiological Worker II (RW-II) Training;
- Entryways shall be locked;
- During periods when access is required, positive control (i.e., RCT's, alarming dosimetry, etc.) over each entrant shall be maintained;
- No control shall be established that would prevent rapid evacuation of personnel;
- Approval for entry obtained from the RCM;
- An As-Low-As-Reasonably-Achievable (ALARA) pre-job briefing shall be conducted prior to entry;
- Radiation survey and supplemental dosimeter shall be provided;
- Area shall be maintained as necessary during access to determine the exposure rates to which individuals are exposed;

- A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below that level defining a high radiation area;
- A device that functions automatically to prevent use or operation of the radiation source or field while personnel are in the area;
- A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry;
- Entryways that are locked. During periods when access to the area is required, positive control over each entry is maintained;
- Continuous direct or electronic surveillance that is capable of preventing unauthorized entry; and,
- A control device that will automatically generate audible and visual alarm signals to alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area or activation of a secondary control device that will prevent use or operation of the source.

6.2.5 Very High Radiation Areas - Any area accessible to individuals shall be posted with the words "Grave Danger, Very High Radiation Area." Currently, no such areas exist or are expected to be encountered at LEHR. If such conditions were to change, a specific procedure would be generated outlining requirements for posting and control.

6.2.6 Airborne Radioactivity Areas - Any area accessible to individuals shall be posted with the words "Caution, Airborne Radioactivity Area." A HWP is required for entry.

Minimum that shall be required:

- General Employee Radiological Training (GERT) – worker, or
- Radiological Worker II (RW-II) Training

6.2.7 Contamination Area - Any area accessible to individuals shall be posted with the words "Caution, Contamination Area." A HWP is required for entry.

Minimum that shall be required:

- General Employee Radiological Training (GERT) – worker (unless RW-II trained, or higher), or
- Radiological Worker II (RW-II) training

6.2.8 Fixed Contamination Area - Any area accessible to individuals should be posted with the words "Caution, Fixed Contamination Area."

Minimum that shall be required:

- General Employee Radiological Training (GERT) – worker, or
- Radiological Worker II (RW-II) training

Entry control and posting are not required for areas of fixed contamination meeting the conditions of Appendix D, 10 CFR 835 and this section.

Markings indicating the status of the area shall be applied to the surface (or at access points) to provide adequate warning. Markings and postings shall be maintained in a legible condition.

Appropriate written procedures shall be implemented to prevent planned or uncontrolled removal of the contamination.

6.2.9 High Contamination Area - Any area accessible to individuals shall be posted with the words "Danger, High Contamination Area." A HWP is required for entry.

Minimum that shall be required:

- General Employee Radiological Training (GERT) – worker, or,
- Radiological Worker II (RW-II)
- Approval for entry must be obtained from the RCM
- An ALARA pre-job briefing shall be conducted prior to entry

6.2.10 Radioactive Material Area - Areas where radioactive materials are used, handled or stored shall be posted with the words "Caution, Radioactive Material."

Minimum Training Required:

- General Employee Radiological Training (GERT) – worker, or,
- Radiological Worker II (RW-II) Training

Radioactive material areas shall be located within Controlled Areas.

Radioactive Material Areas need not be posted when:

- The area is posted as a radiological area in accordance 10 CFR 835;
- Each item or container of radioactive material in the area is clearly labeled to warn individuals of the hazards;
- The area contains only packages of radioactive material received from transportation while awaiting survey; and,

- For periods of eight continuous hours or less, the area is under the direct observation and control of an individual knowledgeable of and empowered to implement required access control measures.

6.2.11 Underground Radioactive Material Areas - should be posted with the words "Underground Radioactive Material."

6.2.12 When an escort is used in lieu of training in accordance with this procedure, the escort shall:

(1) Have completed radiation safety training, examinations, and performance demonstrations required for entry to the area and performance of the work; and,

(2) Ensure that all escorted individuals comply with the documented radiation protection program.

6.3 Posting and Labeling Guidelines

6.3.1 All areas that contain radiological hazards and/or require exposure control shall be clearly designated and conspicuously posted by appropriate signs, tags or labels that may contain radiological protection instructions appropriate to the hazard. Signs, tags, and labels should have a similar design and be DOE approved. During transient radiological conditions of less than 8-hours continuous duration when posting is not practical, individuals who are knowledgeable of and empowered to implement required access and exposure control shall be stationed to provide line-of-sight surveillance and verbal warning. Areas containing only packages received from radioactive material transportation labeled and in non-degraded condition need not be posted in accordance with § 835.603 until the packages are monitored in accordance with § 835.405.

6.3.2 The radiation symbol (trefoil) and the color combination yellow background and magenta/black standard radiation trefoil symbol shall be used on all signs/labels to signify the actual or potential presence of ionizing radiation and to identify objects, devices, materials, or combinations of materials which emit ionizing radiation.

6.3.3 The symbols and color combination of yellow and magenta are not to be used for purposes other than to warn of the actual or potential presence of a radiation or contamination hazard or for training purposes when the signs, barriers, and symbols are clearly identified "For Training Purposes Only."

6.3.4 Each sign, tag or label shall be displayed prominently and must be recognizable from a safe distance. Signs should be placed intermittently along the boundaries of accessible areas, with at least one sign visible on each side of the boundary. Boundaries and barriers should be clearly visible, and established at an elevation that would prevent unintentional entry into radiological areas. The signs and symbols shall be approved by the Department of Energy and conform to ANSI N12.1-1971 and ANSI N2.1-1971.

6.3.5 Each posted area shall be defined and clearly marked with appropriate signs and may include a portion or all of a room, building, area, or vehicle. Areas without clearly defined existing boundaries should be defined by the use of yellow and magenta radiation tape, ribbon, or rope. Postings at entrances to rooms shall be displayed in a manner which allows the posting to remain visible with the door open or closed. Postings shall be visible from each direction from which the area can be easily accessed.

6.3.6 Supplementary notices specifying the requirements for entry to and exit from areas, special precautions that are to be exercised, and the most recent radiological survey for each area should be posted in conjunction with radiation warning signs and tags to provide personnel with any required additional instructions or information not given by the signs and tags.

6.3.7 The information signs, tags, labels, and notices shall be kept current, reflecting any changes in radiological conditions.

6.3.8 Warning signs, tags, labels, notices and other radiation hazard identification markings will be removed when the conditions requiring their use no longer exist.

6.3.9 Each item containing radioactive material above the values listed in Appendix E of 10 CFR 835 shall be labeled with the trefoil and the words "Caution, Radioactive Material" or "Danger, Radioactive Material" if the item is not used, handled, or stored within a posted radiological area. When practical, the label should contain the contact radiation levels, the removable surface contamination levels, the date surveyed, the surveyor's name, and a description of the source.

6.3.10 In situations where more than one radiological condition exists, each condition shall be identified. Multiple radiological conditions should either be posted on individual signs or be combined on a single sign, with the headings listed in descending order of importance.

6.3.11 Radiological postings shall not block access to emergency exits.

6.3.12 Radioactive items or containers of radioactive materials shall be individually labeled if adequate warning is not provided by control measures and required posting.

6.3.13 Each access point to a controlled area shall be posted, identifying it as a controlled area, whenever radioactive material and/or radiation fields that would require posting under Section 10CFR835 may be present in the area. Signs used for this purpose may be selected by the contractor to avoid conflict with local security requirements. Individuals who enter only controlled areas without entering radiological areas or radioactive material areas are not expected to receive a total effective dose equivalent of more than 0.1 rem (0.001 sievert) in a year.

6.3.14 At a minimum, labels shall include the radiation symbol and the words "CAUTION" or "DANGER RADIOACTIVE MATERIAL" and provide information necessary to avoid or minimize exposure.

6.3.15 Radioactive material in quantities exceeding 10 times these listed in Attachment 2 quantities shall be stored in a Radioactive Material Area or other areas posted in accordance with 10 CFR 835.

7.0 DOCUMENTATION/RECORDS

None.

8.0 ATTACHMENTS

8.1 Surface Residual Radioactivity Guidelines

8.2 Values for Establishing Sealed Radioactive Source Accountability With Radioactive Material Posting and Labeling Requirements

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 8.1

SURFACE RESIDUAL RADIOACTIVITY GUIDELINES

Attachment1. Surface Contamination Values[1] in dpm/100 cm^2

Radionuclide	Removable [2,4]	Total (Fixed + Removable)[2,3]
U-nat, U-235, U-238, and associated decay products	[7] 1,000	[7] 5,000
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above[5]	1,000	5,000
Tritium and tritiated compounds[6]	10,000	N/A

[1] The values in this appendix, with the exception noted in footnote 5 below, apply to radioactive contamination deposited on, but not incorporated into the interior or matrix of, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides apply independently.

[2] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[3] The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the surface contamination value if: (1) from measurements of a representative number of sections it is determined that the average contamination level exceeds the applicable value; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds three times the applicable value.

[4] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area shall be based on the actual area and the entire surface shall be wiped. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

[5] This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

[6] Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface contamination value provided in this appendix is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply.

[7] (alpha)

ATTACHMENT 8.2

VALUES FOR ESTABLISHING SEALED RADIOACTIVE SOURCE ACCOUNTABILITY WITH RADIOACTIVE MATERIAL POSTING AND LABELING REQUIREMENTS

Attachment 2. Values for Establishing Sealed Radioactive Source Accountability and Radioactive Material Posting and Labeling Requirements

Less than 300 Ci (10 MBq)

H-3	Be-7	C-14	S-35	Ca-41	Ca-45	V-49	Mn-53
Fe-55	Ni-59	Ni-63	As-73	Se-79	Rb-87	Tc-99	Pd-107
Cd-113	In-115	Te-123	Cs-135	Ce-141	Gd-152	Tb-157	Tm-171
Ta-180	W-181	W-185	W-188	Re-187	Tl-204		

Less than 30 Ci (1 MBq)

Cl-36	K-40	Fe-59	Co-57	Se-75	Rb-84	Sr-85	Sr-89
Y-91	Zr-95	Nb-93m	Nb-95	Tc-97m	Ru-103	Ag-105	In-114m
Sn-113	Sn-119m	Sn-121m	Sn-123	Te-123m	Te-125m	Te-127m	Te-129m
I-125	La-137	Ce-139	Pm-143	Pm-145	Pm-147	Sm-145	Sm-151
Eu-149	Eu-155	Gd-151	Gd-153	Dy-159	Tm-170	Yb-169	Lu-173
Lu-174	Lu-174m	Hf-175	Hf-181	Ta-179	Re-184	Re-186m	Ir-192
Pt-193	Au-195	Hg-203	Pb-205	Np-235	Pu-237		

Less than 3 Ci (100 kBq)

Be-10	Na-22	Al-26	Si-32	Sc-46	Ti-44	Mn-54	Fe-60
Co-56	Co-58	Co-60	Zn-65	Ge-68	Rb-83	Y-88	Zr-88
Zr-93	Nb-94	Mo-93	Tc-95m	Tc-97	Tc-98	Ru-106	Rh-101
Rh-102	Rh-102m	Ag-108m	Ag-110m	Cd-109	Sn-126	Sb-124	Sb-125
Te-121m	I-129	Cs-134	Cs-137	Ba-133	Ce-144	Pm-144	Pm-146
Pm-148m	Eu-148	Eu-150	Eu-152	Eu-154	Gd-146	Tb-158	Tb-160
Ho-166m	Lu-176	Lu-177m	Hf-172	Ta-182	Re-184m	Os-185	Os-194
Ir-192m	Ir-194m	Hg-194	Pb-202	Bi-207	Bi-210m	Cm-241	

Less than 0.3 Ci (10 kBq)

Sr-90	Cd-113m	La-138	Hf-178m	Hf-182	Po-210	Ra-226	Ra-228
Pu-241	Bk-249	Es-254					

Less than 0.03 Ci (1 kBq)

Sm-146	Sm-147	Pb-210	Np-236	Cm-242	Cf-248	Fm-257	Md-258

Less than 0.003 Ci (100 Bq)

Gd-148	Th-228	Th-230	U-232	U-233	U-234	U-235	U-236
U-238	Np-237	Pu-236	Pu-238	Pu-239	Pu-240	Pu-242	Pu-244
Am-241	Am-242m	Am-243	Cm-243	Cm-244	Cm-245	Cm-246	Cm-247
Bk-247	Cf-249	Cf-250	Cf-251	Cf-252	Cf-254		

Less than 0.0003 Ci (10 Bq)

Ac-227	Th-229	Pa-231	Th-232	Cm-248	Cm-250

Notes:

1. The value for any alpha emitting nuclide not listed above and for mixtures of unknown alpha emitters is < 0.001 µCi [see 835, Appendix E].
2. The value for any non-alpha emitting nuclide and for mixtures of these nuclides of unknown composition is < 0.01 µCi [see 835, Appendix E].

When the radioactive material consists of a mixture of known quantities of listed nuclides, determine the value by summing the fractions of the quantity of each radionuclide divided by the accountability value for that nuclide. If the sum of the fractions exceeds unity (1), the value has been exceeded [see 835, Appendix E].

RADIOLOGICAL SURVEYS AND INSTRUMENTATION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes the requirements for performing radiological surveys and the requirements for radiological survey instrumentation at LEHR.

2.0 REFERENCES

2.1 *ANSI N323, "Radiation Protection Instrumentation Test and Calibration," 1978*

2.2 *10 CFR 835, "Occupational Radiation Protection"*

2.3 *SOP 24.1, "Radiological Areas and Posting"*

2.4 *SOP 38.3, "Radiation Protection Records"*

2.5 *SOP 25.2, "Radiological Survey Forms"*

3.0 DEFINITIONS

3.1 Air Monitoring

Actions to detect and quantify airborne radiological conditions by the collection of an air sample and the subsequent analysis, either in real-time or offline laboratory analysis, of the amount and type of radioactive material present in the workplace atmosphere.

3.2 Airborne Radioactivity Area

Means any area, accessible to individuals, where: (1) the concentration of airborne radioactivity, above natural background, exceeds or is likely to exceed the derived air concentration (DAC) values listed in Appendix A or Appendix C of 10CFR835; or (2) an individual present in the area without respiratory protection could receive an intake exceeding 12 DAC-hours in a week.

3.3 Calibration

The process of adjusting or determining either:

- The response or reading of an instrument relative to a standard (e.g., primary, secondary, or tertiary) or to a series of conventionally true values; or,
- The strength of a radiation source relative to a standard (e.g., primary, secondary, or tertiary) or conventionally true value.

3.4 Chi Square Test

A statistical test used to check the stability of a counting system by comparing a given set of detector measurements against those theoretically expected from a Poisson distribution.

3.5 Contamination

The presence of radioactivity in unwanted areas (i.e., surfaces of structures, objects, areas, or personnel).

3.6 Controlled Area

Any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive materials.

3.7 Derived Air Concentration (DAC)

For the radionuclides listed in Appendix A of 10 CFR 835, the airborne concentration that equals the Annual Limit on Intake (ALI) divided by the volume of air breathed by an average worker during a working year of 2000 hours (assuming a breathing volume of 2.4E3 m^3).

3.8 Instruments

Measuring equipment, devices, or systems used to quantify, test, gage, inspect, or control in order to acquire data or determine compliance with project specifications.

3.9 Source Check

Test of measuring equipment against a source of known intensity or concentration to measure functionality. Typically performed daily or prior to use. A source check is not a calibration.

3.10 Ionizing Radiation

Alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used herein, does not include non-ionizing radiation, such as radio or micro-waves, or visible, infrared, or ultraviolet light.

3.11 Removable Contamination

The fraction of the total surface radioactive contamination that can be readily removed by non-destructive means, such as casual contact, wiping, brushing, or washing.

3.12 Total Surface Contamination

The total activity of radioactive material on the surface of an object, where total surface contamination = removable contamination + fixed contamination.

4.0 RESPONSIBILITIES

4.1 Project Manager (PM)

The PM is responsible for the safe and effective implementation of this procedure.

4.2 Radiological Control Manager (RCM)

The RCM is responsible for ensuring all field activities are performed in compliance with this procedure.

4.3 Radiation Safety Officer (RSO)

The RSO is responsible for ensuring that all Radiological Control Technicians (RCTs) are properly trained on this procedure, and that the posting(s) at each radiological area reflect the most current survey of that area.

4.4 Radiological Control Technicians (RCTs)

The RCTs are responsible for the performance of the work described in this procedure.

5.0 SAFETY PRECAUTIONS/PREREQUISITES

Personnel conducting surveys shall be aware of the radiological and hazardous conditions of the areas/items to be surveyed.

Instruments used for release surveys should: (1) be appropriate for the type of contamination to be detected; (2) have an MDA less than the release limits shown in Appendix D of 10 CFR 835; and, (3) be in current calibration (at least annually).

All items that meet the criteria for uncontrolled release from a radiological area or Radiologically Controlled Area should be removed as soon as practical following the release survey.

Applicable Hazardous Work Permits (HWP) will be read, understood, and signed by all survey personnel prior to conducting surveys.

All survey personnel will wear the appropriate personal protective equipment listed in the HWP while conducting surveys.

All survey instruments shall have a current calibration, and be source and background checked on the day of use, and be visually inspected prior to use.

Personnel shall be trained on the proper operation, use, and application of the survey equipment.

6.0 PROCEDURE

6.1 Surveys

The types of surveys required to ensure adequate identification, control, and documentation of radiological hazards during field investigation, waste packaging, and decommissioning and decontamination (D&D) activities at LEHR are described below. Radiological surveys shall be performed only by trained and qualified personnel.

The minimum detectable activity (MDA) with a 0.05 probability of Type I or Type II errors (95% confidence level) should be calculated for each instrument/counting system. This information can be used to determine if a system can detect contamination levels required to meet approved release criteria or contamination limits.

Counting room equipment shall be routinely tested for operability. Daily performance checks of background count rate and radiation response should be performed on the counting system. A Chi Square test should be performed monthly on the counting system to determine variations about the mean count rate to ensure that the system remains within calibration throughout the calibration interval.

6.1.1 Area Surveys

Area surveys are performed to identify and quantify radiation and contamination in areas and on items. Area surveys include radiation, contamination, and airborne surveys. The frequency of area surveys is discussed below.

6.2 Radiation Surveys

6.2.1 Radiation surveys should include dose rates as follows:

- at contact with source;
- at 30 cm from source;
- in the general area of interest in work area; and,
- at identified area boundaries.

Routine radiation surveys should be performed in accordance with the following minimum frequencies:

- Daily, in office space located in Radiological Buffer Areas and other areas surrounding radiological areas where the potential exists for external radiation exposure.
- Weekly, in routinely occupied Radiological Buffer Areas and Radiation Areas.
- Weekly, for operating HEPA-filtered ventilation units.
- Weekly, for temporary Radiation Areas boundaries to ensure that radiation areas do not extend beyond posted boundaries.
- Monthly, or upon entry if entries are less frequent than monthly, for Radioactive Material Areas.
- Monthly, for potentially contaminated ducts, piping, and hoses in use outside radiological facilities.

The RSO or RCM should approve the frequency and extent of surveys not mandated by 10 CFR 835.

6.2.2 Radiation surveys are a means to verify effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure.

6.2.3 Radiation surveys on received radioactive material packages shall be performed:

- When the quantity of received radioactive material exceeds a Type A quantity (as defined in 10 CFR 71.4) and the packaged is labeled with a Radioactive White I or Yellow II or III label (as specified in 49 CFR 172.403 and 172.436-440).
- When the radioactive material has been transported as low specific activity material on an exclusive use vehicle (as defined in 10 CFR 71.4).

These surveys are used to ensure compliance with Department of Transportation regulations and applicable DOE Orders and to identify appropriate postings and access control measures. These measures should be established as soon as practicable after receipt.

Monitoring shall include:

- Measurements of removable contamination levels, unless the package contains only special form (as defined at 10 CFR 71.4) or gaseous radioactive material; and,
- Measurements of the radiation levels, unless the package contains less than a Type A quantity (as defined at 10 CFR 71.4) of radioactive material.

The monitoring required shall be completed as soon as practicable following receipt of the package, but not later than 8 hours after the beginning of the working day following receipt of the package.

6.2.4 Surveys shall also be performed when a received package shows evidence of damage, such as packages that are crushed or wet.

6.2.5 Surveys of received packages shall be performed within three hours of receipt, if received normal working hours, or within three hours from the beginning of the next working day, if received outside of normal working hours.

6.3 Contamination Surveys

6.3.1 Contamination surveys should be conducted in Radiological Buffer Areas and other areas surrounding radiological areas established for the control of contamination and other areas with the potential for spread of contamination as follows:

- Prior to transfer of equipment and material from one Radiological Buffer Area to another.
- Prior to transfer of equipment and material from High Contamination Areas within Radiological Buffer Areas unless precautions such as bagging or wrapping are taken prior to transfer.
- Daily, at contamination areas control points, change areas, or step-off pads when in use, or per shift in high use situations.
- Daily, in office space located in Radiological Buffer Areas.
- Daily, in lunchrooms or eating areas near Radiological Buffer Areas.
- Weekly, in routinely occupied Radiological Buffer Areas.
- Weekly, or upon entry if entries are less frequent, in areas where radioactive materials are handled or stored.
- Weekly, or upon entry if entries are less frequent, where contamination area boundaries or postings are located.
- During initial entry into a known or suspected contamination area, periodically during work, at completion of job, or as specified in a Radiological Work Permit.

- Weekly, in and around areas of fixed contamination.
- After a leak or spill of radioactive materials.

The RSO or RCM should approve frequency and extent of surveys not mandated by 10 CFR 835.

6.3.2 Release of Material from Contaminated Areas to Controlled Areas

All material removed from Contaminated Areas shall be surveyed prior to release, and shall have contamination levels less than values shown in Appendix D, 10 CFR 835.

Radioactive material that exceeds the values shown in Appendix D, 10 CFR 835, that need to be removed to other areas shall be packaged, labeled, and escorted by RCTs. Items shall be controlled through use of postings, inventories, and frequent surveys.

6.3.3 Release of Material from Contaminated Areas to Uncontrolled Areas

All material removed from Contaminated Areas shall be surveyed prior to release, and shall have contamination levels less than values shown in Appendix D, 10 CFR 835.

DOE 5400.5 and NRC Regulation Guide 1.86 describe radiological criteria for releasing material to uncontrolled areas.

Material shall be evaluated for potential internal contamination or contamination under coating or paint. This often involves taking a material's history into consideration, as well as process knowledge.

All radiological labeling or marking shall be removed prior to release.

All released material shall be removed from applicable radioactive material inventories.

6.3.4 Contamination surveys shall be performed on received packages of normal form radioactive material (as specified in 10 CFR 71.4):

- When the package is labeled with a Radioactive White I, Yellow II, or Yellow III label (as specified at 49 CFR 172.403 and 172.436-440); and,
- When the radioactive material has been transported as low specific activity material on an exclusive use vehicle (as defined in 10 CFR 71.4).

These surveys are used to ensure compliance with Department of Transportation regulations and to identify appropriate postings and access control measures. These measures should be established as soon as practicable after receipt.

6.3.5 Surveys shall also be performed when a received package shows evidence of damage, such as packages that are crushed or wet.

6.3.6 Surveys of received packages shall be performed within three hours of receipt, if received during normal working hours, or within three hours from the beginning of the next working day, if received outside of normal working hours.

6.3.7 Items with inaccessible surfaces that were located in known or suspected contamination areas and had the potential to become contaminated at levels likely to exceed Appendix D, 10 CFR 835, values shall be treated as potentially contaminated and subject to administrative controls unless the items are dismantled and monitored or special survey techniques are used to survey all surfaces.

6.3.8 Total (direct) contamination surveys are performed at the following distances from the surface of items:

- scanning surveys: the bottom edge of the probe is held 0.6 cm (0.25 in) from the surface; and,
- static surveys: the probe is in contact with the surface, unless the surface is known or suspected of being contaminated.

6.4 Airborne Radioactivity Surveys

6.4.1 Discussion

6.4.2 Airborne radioactivity monitoring is required when airborne radioactivity levels have the potential to increase because early detection can minimize internal exposure of radioactive material. Selection of the type of sampling equipment should be based on type of work being performed, job duration, and any limiting factors, (i.e., explosive atmosphere, structural limitations, worker mobility, etc.). Air monitoring equipment includes portable, fixed station sampling, and continuous air monitors (CAM) or combination thereof.

Airborne radioactivity surveys fall into three categories: area, personnel, and containment ventilation surveys. The requirements for each of these surveys are described below.

Airborne radioactivity area surveys are required in any room, enclosure, or operating area where work is being performed which has the potential to cause airborne radioactivity. The samplers should be run continuously during the work activities or during the periods when the highest levels of airborne activity are expected for that area during a work shift.

The minimum detectable activity (MDA) with a 0.05 probability of Type I or Type II errors (95 % confidence level) should be calculated for each sampling/counting system. This information can be used to determine if a system can detect the minimum air concentrations required to meet workplace air monitoring requirements given in 10CFR835.403.

Counting room equipment shall be routinely tested for operability. Daily performance checks of background count rate and radiation response should be performed on the counting system. A Chi Square test should be performed monthly on the counting system to determine variations about the mean count rate to ensure that the system remains within calibration throughout the calibration interval. Periodic grab samples are collected outside contamination control enclosures. Initially these samples will be collected daily. The frequency may be reduced if experience shows minimal airborne radioactivity i.e., less than one percent of the DAC.

Personnel breathing zone (BZ) samples are collected as needed for individual workers when it is suspected that specific field activities may generate excessive amounts of airborne radioactivity (exposure is likely to exceed 40 DAC-hours in a year). BZ surveys require a lapel air sampler.

Sample flow rates may vary depending upon the specific application, but should always allow collection of a sample volume adequate to ensure the minimum detectable activity of the sampling and counting system is no greater than 2% of an ALI.

Continuous sampling of containment ventilation exhausts will be performed while field activities are being performed which could cause airborne radioactivity within a building or containment.

Note: When collecting air samples from exhaust ventilation systems, the sampling system should be designed and operated to obtain isokinetic samples. Hyperkinetic samples are acceptable because they will over-estimate the radioactivity in the containment ventilation exhaust. Sampler filters are to be changed at least weekly and are evaluated for compliance with the DACs. If containment ventilation exhaust sample results indicate levels that, on a weekly basis, exceed the DACs, operations shall be discontinued until engineering controls are implemented to reduce the airborne radioactivity to acceptable levels.

6.4.3 Air sampling equipment shall be staged such that the air concentrations being measured are representative to which personnel are being exposed.

6.4.4 All air monitoring equipment shall be maintained and calibrated at least once per year. Continuous Air Monitors (CAMs) shall be capable of measuring 1 DAC when averaged over eight hours, and an operational check shall be performed daily. Pocket and electronic dosimeters and area radiation monitors shall be calibrated at least every 12 months.

6.4.5 Air monitoring (in addition to surveys) in the workplace shall be routinely performed, as necessary, to identify and control potential sources of personnel exposure to radiation and/or radioactive material and to identify areas requiring postings in accordance to SOP 24.1, *Radiological Areas and Posting* (Reference 2.3).

6.5 General

Radiation, contamination and airborne radioactivity surveys shall be performed only by RCTs.

All radiation, contamination and airborne radioactivity surveys shall be documented. Documentation shall be completed using the forms and instructions in Attachment 1, “Radiological Survey Log.”

Radiation, contamination and airborne radioactivity surveys should include a map or drawing of the area or item being surveyed, indicating the locations of dose rate readings, smear samples, and air samplers.

Radiation, contamination and airborne radioactivity surveys shall be reviewed by the RSO for completeness and trending of area conditions.

6.6 Monitoring of Individuals and Areas

Monitoring of individuals and areas shall be performed to:

- Demonstrate compliance with the regulations in 10 CFR 835;
- Document radiological conditions;
- Detect changes in radiological conditions;
- Detect the gradual buildup of radioactive material;
- Verify the effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure; and,
- Identify and control potential sources of individual exposure to radiation and/or radioactive material.

6.7 Radiation/Contamination Survey Instrumentation

6.7.1 Instrumentation used for monitoring shall be readily available and of sufficient accuracy to determine the extent of radiological hazards to which employees are exposed, and shall be appropriate for the types, levels and energies of the radiation/contamination encountered or expected and for which their calibrations are valid. Instrumentation shall also be appropriate for existing environmental conditions and routinely tested for operability.

6.7.2 Prior to purchase, instruments shall be evaluated, tested, and calibrated by the manufacturer.

6.7.3 Instruments shall be evaluated and tested as applicable for:

- Physical construction;
- Effect of shock, sound, vibration, electric transients, radio frequency energy, magnetic fields and high humidity;
- Extent of switching transients, capacitance effects, geotropism and static charge effects;
- Power supply, including stability and battery life;
- Range, sensitivity, linearity, detection limit, and response to overload conditions;
- Accuracy and reproducibility (precision);
- Energy dependence;
- Angular dependence;

- Response to ionizing radiation other than that being measured; and,
- Temperature and pressure dependence on measurements.

6.7.4 Instrumentation shall be calibrated using the guidelines of ANSI N323, "Radiation Protection Instrumentation Test and Calibration," (Reference 2.1) with the following additional requirements/exceptions:

- On a case-by-case basis, the calibration of a high-range instrument at 80 percent of full scale on the high scale may be waived by the RSO;
- Instruments shall be calibrated annually; and,
- Calibrations shall use National Institute of Standards and Technology Traceable Sources.

6.7.5 Prior to each use or daily when kept in use each instrument shall have the following inspection conducted (as applicable):

- A battery check;
- A test of the reset button;
- A test of the audible response;
- A check of the zero;
- An examination for physical damage;
- A verification that the calibration sticker is on the instrument and the instrument is in calibration;
- A background check; and,
- A source response check on at least one scale.

6.7.6 In addition to 6.2.3, an instrument should be tested weekly against a reference standard source in a fixed geometry on at least one scale. The instrument reading, when corrected for efficiency and background and source units (dpm, pCi, mrem/hr, etc.), should be within 20 percent of the standard's value.

6.7.7 Instruments failing any of the activities in 6.2.3 and 6.2.4 shall be taken out of service, tagged as "out of service," evaluated for failure, and repaired or reset-up prior to use.

6.7.8 Each instrument shall be labeled with a unique identifier to enable traceability to surveys and records.

6.7.9 The instrument checks, as required, will be recorded on the instrument check sheet (SOP 25.2, Attachment 8.5).

7.0 DOCUMENTATION/RECORDS

7.1.1 A log shall be maintained of all surveys. All surveys need to be listed in numerical order on log, and filed in numerical order. Original copies should be maintained in a locked fireproof file cabinet. The log sheet is shown in Attachment 1.

7.1.2 A project file shall be maintained for each instrument documenting its inspection, calibration, and maintenance history.

7.1.3 Changes in equipment, techniques, and procedures used for monitoring in the workplace shall be documented.

7.1.4 Records are to be retained as per SOP 38.3, *Radiation Protection Records* (Reference 2.4).

8.0 ATTACHMENTS

8.1 Radiological Survey Log

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 8.1

RADIOLOGICAL SURVEY LOG

ATTACHMENT 2

RADIOLOGICAL SURVEY LOG SHEET

INTERNATIONAL TECHNOLOGY CORPORATION

RADIOLOGICAL SURVEY LOG

SURVEY NUMBER	SURVEY DATE	SURVEY BY	DESCRIPTION

RADIOLOGICAL SURVEY LOG

SURVEY NUMBER	SURVEY DATE	SURVEY BY	DESCRIPTION	RELEASED TO (Only if survey is conducted for release of material; otherwise check N/A)
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐

Abbreviation

N/A not applicable

RADIOLOGICAL SURVEY FORMS

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes the requirements for documenting radiological surveys and equipment setup and performance checks at LEHR.

2.0 REFERENCES

2.1 10 CFR 835, "Occupational Radiation Protection"

2.2 SOP 38.3, "Internal and External Dosimetry and Radiation Protection Records"

2.3 SOP 25.1, "Radiological Surveys And Instrumentation"

3.0 DEFINITIONS

3.1 Calibration

The process of adjusting or determining either:

- The response or reading of an instrument relative to a standard (e.g., primary, secondary or tertiary) or to a series of conventionally true values; or,
- The strength of a radiation source relative to a standard (e.g., primary, secondary or tertiary) or conventionally true value.

3.2 Instruments

Measuring equipment, devices, or systems used to quantify, test, gauge, inspect, or control in order to acquire data or determine compliance with project specifications.

3.3 Source Check

Test of measuring equipment against a source of known intensity or concentration to measure functionality. Typically performed daily or prior to use. A source check is not a calibration.

4.0 RESPONSIBILITIES

4.1 Project Manager (PM)

The PM is responsible for the safe and effective implementation of this procedure.

4.2 Radiation Safety Officer (RSO)

RSO is responsible for ensuring that all Radiological Control Technicians (RCTs) are properly trained on this procedure, and that the attached forms are used as required.

4.3 Radiological Control Technicians (RCTs)

The RCTs are responsible for the proper completion, legibility and documentation of the forms in this procedure.

5.0 SAFETY PRECAUTIONS/PREREQUISITES

5.1 RCTs

RCTs shall be aware of the radiation hazards associated with instrument check sources and shall store radioactive sources in a secure, locked location that shall identify the presence of radioactive material through the application of postings or labels (stickers).

5.2 Personnel

Personnel shall be trained on the proper operation, use, and application of the survey equipment.

6.0 PROCEDURE

6.1 Discussion

6.1.1 All radiological surveys shall be performed in accordance with SOP 25.1 "Radiological Surveys And Instrumentation," (Reference 2.3).

6.2 Radiological Survey Form

RCTs shall document surveys performed to identify and quantify radiation and contamination in areas and on items on a Radiological Survey Form (Attachment 1). When necessary, the continuation sheet will be used (Attachment 2).

6.2.1 The RSO shall review all completed survey forms.

6.2.2 The RSO shall maintain a Radiological Survey Log (Attachment 3) for all radiological surveys performed at the LEHR site.

6.2.3 All surveys shall be maintained in a project file for easy retrievability and reference.

6.3 Airborne Survey Form

6.3.1 All airborne radioactive monitoring shall be conducted in accordance with SOP 25.1, "Radiological Surveys And Instrumentation," (Reference 2.3).

6.3.2 RCTs shall document calculations for airborne radioactivity on Radioactive Airborne Contamination Survey Report forms (Attachment 4).

6.3.3 The RSO shall review all completed Radioactive Airborne Contamination Survey Report forms (Attachment 4).

6.3.4 All airborne radioactive survey forms shall be maintained in a project file for easy retrievability and reference.

6.4 Radiation / Contamination Survey Instrumentation Setup

6.4.1 Upon arrival at the LEHR site, all instrumentation shall:

- be verified against procurement purchase order;
- be inspected for damage;
- have calibration certificates inspected and entered into files;
- have background determined and be source response checked;
- have instrument efficiency determined (as applicable); and,
- have instrument minimum detectable activity (MDA) and lower limit of detection (LLD) determined (as applicable).

6.4.2 Instrument Data Forms:

- Background and source checks shall be documented on the "Scaler Daily Source Check" form, (Attachment 5).
- Instrument efficiencies shall be documented on "Scaler Setup Sheet" form, (Attachment 6).

6.4.3 RCTs shall establish, on a monthly basis, average background and efficiency for all scaler instruments used at the LEHR site. "Scaler Setup Sheet" forms (Attachment 6), shall be used to document the values used, calculations, and the final average values for background and efficiency obtained for each instrument.

6.4.4 The RSO shall review all completed "Scaler Setup Sheet" forms.

6.4.5 RCTs shall document the performance of daily background and source checks on "Scaler Daily Source Check" form (Attachment 5).

6.4.6 The RSO shall review all survey forms, and instrument data forms upon completion. Forms shall be maintained in a project file for easy retrievability and reference.

7.0 DOCUMENTATION/RECORDS

The RSO shall retain all records generated by this procedure in compliance with SOP 38.3, "Internal and External Dosimetry and Radiation Protection Records," (Reference 2.2) and in compliance with 10 CFR 835, "Occupational Radiation Protection," (Reference 2.1).

8.0 ATTACHMENTS

8.1 Radiological Survey Form

8.2 Radiological Survey Form Continuation Sheet

8.3 Radiological Survey Log

8.4 Radioactive Airborne Contamination Survey Report

8.5 Scaler Daily Source Check

8.6 Scaler Setup Sheet

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 8.1

RADIOLOGICAL SURVEY LOG

RADIOLOGICAL SURVEY FORM

Survey Number ____________________

Survey Description: ______________________
Drawing Attached: Yes No

Instrument (1)
Instrument Model: __________________
Instrument Ser. #: __________________
Calibration Due: __________________
Efficiency: __________________
MDA: CF: BKG:

Instrument (3)
Instrument Model: __________________
Instrument Ser. #: __________________
Calibration Due: __________________
Efficiency: __________________
MDA: CF: BKG:

Survey Date: ______________________
Survey By: ________________ / __________
Signature Date
Print Name: ______________________
Review By: ________________ / __________
Signature Date

Instrument (2)
Instrument Model: __________________
Instrument Ser. #: __________________
Calibration Due: __________________
Efficiency: __________________
MDA: CF: BKG:

Instrument (4)
Instrument Model: __________________
Instrument Ser. #: __________________
Calibration Due: __________________
Efficiency: __________________
MDA: CF: BKG:

Survey Point	Smearable Contamination		Fixed Contamination		Radiation Level (µR/hr)	Instrument Used	Additional Comments
	beta/gamma dpm/100cm^2	alpha dpm/100cm^2	beta/gamma dpm/100cm^2	alpha dpm/100cm^2			

ATTACHMENT 8.2

RADIOLOGICAL SURVEY FORM CONTINUATION SHEET

RADIOLOGICAL SURVEY FORM CONTINUATION SHEET

Survey Number ____________________

Survey Point	Smearable Contamination		Fixed Contamination		Radiation Level (μR/hr)	Instrument Used	Additional Comments
	beta/gamma dpm/100cm^2	alpha dpm/100cm^2	beta/gamma dpm/100cm^2	alpha dpm/100cm^2			

ATTACHMENT 8.3

RADIOLOGICAL SURVEY LOG

RADIOLOGICAL SURVEY LOG

SURVEY NUMBER	SURVEY DATE	SURVEY BY	DESCRIPTION	RELEASED TO (Only if survey is conducted for release of material; otherwise check N/A)
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐
				N/A ☐

Abbreviation

N/A not applicable

ATTACHMENT 8.4

RADIOACTIVE AIRBORNE CONTAMINATION SURVEY REPORT FORM

RADIOACTIVE AIRBORNE CONTAMINATION SURVEY REPORT

SAMPLE IDENTIFICATION　　　　　　　　　　AIR SAMPLE RECORD #

SAMPLE LOCATION	REASON FOR SAMPLE	HWP NUMBER	SAMPLED BY

SAMPLE TYPE (all collection effiencies 0.95): [ ] 47 mm (membrane) [ ] PAM (filter) [ ] 4" (filter)

SAMPLER S/N	MODEL CAL DUE	ON	DATE TIME	OFF	DATE TIME	TOTAL TIME	FLOW ON	FLOW OFF	AVERAGE FLOW RATE	SAMPLE VOLUME
						min	LPM	LPM	LPM	ml

AVERAGE FLOW = (FLOW ON + FLOW OFF) / 2	VOL = (MIN)(CFM)(2.832E4) OR (MIN)(LPM)(1000)	CALCULATED BY / PRINT / SIGNATURE

SAMPLE ANALYSIS　　COUNT NUMBER:

COUNTER S/N	MODEL CAL DUE	EFF	COUNT	DATE TIME	TOTAL COUNTS	COUNT DURATION	GROSS CPM	BKGD CPM	NET CPM	ACTIVITY
Alpha					COUNTS	MIN	GCPM	BCPM	NCPM	DPM
Beta					COUNTS	MIN	GCPM	BCPM	NCPM	DPM

GCPM = TOTAL COUNTS + COUNT LENGTH　　NCPM = GCPM - BCPM　　ACTIVITY = NCPM / EFF

CALCULATION OF MINIMUM DETECTABLE CONCENTRATION (MDC) AND AIR ACTIVITY CONCENTRATION (AC)

MDC & ACTIVITY CONCENTRATION EQUATI	AIR ACTIVITY CONCENTRATION AND MDC CALCULATIONS		CONCENTRATION
MDC = (MDA IN DPM A or B)(4.74 / arv	Alpha MDC	4.74E-07 / 0.7	uCi/ml
Ac = (ACTIVITY A or B)(4.74E-7) / arv	Beta MDC		uCi/ml
a = 0.7 for filter paper alpha = 1.0 for all others	Alpha Ac	4.74E-07 / 0.7	uCi/ml
r = fraction of sample counted = 0.29 for 4" filter cut to 1 7/8" = 1.0 for all others lume of sample in ml	Beta Ac		uCi/ml

CALCULATION OF MINIMUM DETECTABLE DAC FRACTION (MDDF) AND DAC FRACTION (DF)

DAC VALUES		DAC FRACTION CALCULATION	FRACTION	TOTAL
Alpha Isotope ______	Alpha M	Alpha MDC / DAC Value	MDDF	
DAC Value ______	Beta MD	Beta MDC / DAC Value	MDDF	
Beta Isotope ______	Alpha D	Alpha Ac / DAC Value	DF	
DAC Value ______	Beta DF	Beta Ac / DAC Value	DF	

REMARKS: ____________________

SAMPLE ANALYSIS PERFROMED BY: ____________ / ____________ / ____________

(PRINT)　　(SIGN)　　(DATE/TIME)

ATTACHMENT 8.5

SCALER DAILY SOURCE CHECK

SCALER SETUP SHEET

Project Name/# ____________________ Date/Time ____________________
Instrument/# ____________________ Date Calibrated ____________________
Probe Type/# ____________________ Source Activity ____________ dpm
Technician ____________________ Source Type ____________________
HV Check/Setting ____________________

1. Total Background Counts observed: record counts in 1 - 10

Count Time ____________ minutes

1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Average Counts = ____________ counts

Average count rate = ____________ cpm

Standard Deviation Bkg ____________ counts

Sum of Squares = ____________

2. Total Source Counts observed: record in 1 - 10

1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Average source count= ____________ counts

Avg Source Ct Rate = ____________ cpm

Std Dev Source cts= ____________ counts

Sum of Squares = ____________

Net source cts = ____________ counts

Std. Dev. Net = ____________ counts

Net Ct. Rate = ____________ cpm

MDA= ____________ dpm/100 cm^2

Efficiency = ____________ cpm/dpm

Corr. Factor ____________ dpm/cpm

LLD= ____________ counts

RSO REVIEW ______________________________ Date ____________________

ATTACHMENT 8.6

INSTRUMENT CHECK SHEET

Scaler Daily Source Check

Instrument # ______________________ Setup Date ______________
Cal Date ______________________ Source ID ______________
Probe # ______________________ Project/# ______________

Ranges:

BKG: __________ cpm to __________
Source __________ cpm to __________

Date	Source Reading	Background Reading	Sat/ Unsat	Technician Initials	Additional Comments

Completed By: ______________________ Date ______________
Reviewed By: ______________________ Date ______________

DRUM CRUSHER OPERATION AND SERVICING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE/SCOPE

This document provides instructions for the operation and servicing of the Cives Drum Crusher Model 155DC. This procedure describes the equipment and details the steps required to start, stop, and maintain efficient operation. Additional operational and maintenance information can be found in the instruction manual.

2.0 REFERENCES

2.1 *Project Health and Safety Plan*

2.2 *SOP 6.3 - Decontamination Procedures*

2.3 *Instruction Manual for Cives Drum Crusher, Model 155DC*

3.0 DEFINITIONS

3.1 H&S

Health and Safety

3.2 HWP

Hazardous Work Plan

4.0 RESPONSIBILITIES

4.1 Personnel Responsibilities

4.1.1 The Project Manager is responsible for the safe and effective implementation of this procedure.

4.1.2 The Field Coordinator is responsible for the equipment and the servicing of any particular part.

4.1.3 The Site Health and Safety Officer (SHSO) will ensure that the radiological safety and survey coverage is available before work is initiated. The SHSO is responsible for ensuring that operating/ servicing personnel are properly trained in the radiological and industrial safety concerns/action applicable to work with this equipment.

4.1.4 The Radiological Control Technicians (RCTs) are responsible for conducting all radiation, contamination, and airborne surveys during the performance of this procedure.

4.1.5 Work personnel are responsible for performing the work outlined in this procedure in accordance with its requirements and those of the applicable HWP.

5.0 SAFETY PRECAUTIONS

5.1 Drum crusher

5.1.1 Stop the machine and disconnect electrical power before opening electrical control box, cleaning or servicing machine, or making any adjustments.

5.1.2 Always operate the machine with the door closed and the latch locked. The door must be closed and latched for the machine to operate.

5.1.3 If the machine is being used to crush a drum, make sure the drum plug is removed, or a hole is punched in the top of the drum to allow air to escape. Set the open plug or hole under the hole in the platen.

5.1.4 Noise levels produced by the Drum Crusher will vary with the work application, and may require ear protection to be worn by the operator and adjacent personnel as specified by the SHSO. Monitoring of noise levels and hearing protection shall be in accordance with the PHSP and as directed by the SHSO.

5.1.5 Face and eye protection is required at all times for the Drum Crusher operator and adjacent personnel. This protection will either be a full faced respirator or safety glasses and faceshield as specified by the SHSO. Leather work shoes will be required for the Drum Crusher operator and adjacent personnel.

5.1.6 The Drum Crusher will be used only in contamination control enclosures or building volumes which have HEPA-filtered exhaust systems.

5.1.7 Air sampling for airborne radioactivity shall be conducted in the work areas during Drum Crusher operation, in accordance with the Project Health and Safety Plan (PHSP) and HSP 14.1, "Airborne Radioactivity Monitoring," and as directed by the SHSO.

5.1.8 The number of people in the vicinity of an operating Drum Crusher should be kept to a minimum as directed by the Field Coordinator.

5.1.9 Do not place liquids, aerosol cans or compressed gas cylinders into the crusher. If in doubt as to whether an item may be compacted, consult the Field Coordinator.

5.1.10 Only dry materials shall be placed into the drum crusher. Materials having observable moisture shall be segregated until dry or disposed of without crushing.

5.1.11 After final use, the drum crusher will be decontaminated in accordance with SOP 6.3 "Decontamination Procedures," and the PHSP.

6.0 PREREQUISITES

Prior to operating the unit, verify that the equipment maintenance requirements are met as described in Section 7.3.

6.1 Personnel

6.1.1 Personnel shall understand and comply with HWP(s) and protective clothing requirements for drum crusher operations.

6.1.2 Personnel who operate and/or service the Drum Crusher will complete an applicable training program administered by H&S prior to performing work. Documentation of drum crusher training shall be kept in the project files.

7.0 PROCEDURE

7.1 Equipment Description

The Drum Crusher consists of the crusher body which accommodates a single 55 gallon drum, and a hydraulic cylinder which provides the vertical crushing force. The cylinder is connected to a platen which is sized to either crush the drum contents or the drum itself.

7.2 Operation

7.2.1 Preparing for start-up

1. Move the crusher to the desired location and mark the floor for the locations of the four anchor bolts.
2. Place shims under the base flanges as required to provide firm support at the four anchoring locations.

3. Tighten anchor bolts in accordance with recommendations of the anchor bolt manufacturer.
4. For sound concrete floors, use a 1/2 inch bolt with an expanding steel anchor sleeve.
5. Remove the oil reservoir breather plug and check that the oil level is 2 inches from the top of the reservoir. Add oil if necessary, as described in Section 7.3.
6. Screw in the breather cap.
7. Check all hydraulic fittings for tightness.
8. Remove all packing materials and accessories that may be inside the machine.

7.2.2 Raising the Cylinder

1. The cylinder is raised to its operating position after the machine base is shimmed and anchored to the floor.
2. Remove any strapping or packing that may be holding the platen, cylinder or hoses. Do not remove any wood blocking that supports the crushing platen.
3. Check to see that the pump motor rotation is correct by jogging the STOP and START buttons for 2 - 3 seconds only. If the cylinder is already raised and bolted in place, jog with the STOP and UP buttons.
4. Observe the pump/motor shaft rotation through the sight holes to see if the rotation is the same as the indicating arrow. Pump rotation is clockwise, looking at the shaft end of the pump. The cylinder will rise if rotation is correct.
5. If rotation is incorrect, turn off the power and reverse any two wires on the load side of the disconnect switch. Repeat steps c and d of this section (7.2.2).
6. Make sure the cylinder hoses are free of obstructions.
7. Continue to jog the cylinder up, guiding the cylinder so that hoses and fittings clear the crown area as the cylinder rises. As the cylinder flange approaches the crown, align the cylinder plate between the guide blocks.
8. Put bolts and lock washers in place when the cylinder is in place.
9. Raise the platen slightly by pushing the UP/EJECT and STOP buttons. Remove all cribbing material that is below the platen.
10. Cycle the platen all the way up. Make sure the oil level is 2 in. from the top of the reservoir. Add oil if necessary, as described in Section 7.3.
11. Check and secure all mechanical fasteners and clear away all debris from in and around the machine.
12. Run through a complete cycle, checking all safety switches and push buttons.

13. Make sure that the machine cannot operate unless the door is closed, and that the emergency stop button is operational and will immediately stop machine operation when pressed.

7.2.3 Control Functions

1. STOP - Large red button on control box. When pressed, the machine will stop instantly with the platen at any position. Press to lock in OFF position, and pull to unlock.
2. AUTO/START - Green button on control box. When pressed, the machine will start, the platen will travel down to bottom limit, stop, automatically reverse, travel up to top limit, and the machine will stop.
3. UP - Yellow button on control box. When pressed, platen will travel up whether the machine is running or stopped. Platen will travel to top limit and stop.
4. POWER ON - Green indicating light on control box. It is lit when there is power to the machine.
5. DOOR/LATCH - Must be closed for machine to operate.

7.2.4 General Operation - In drum compaction

1. Turn on power to the machine.
2. Raise the platen by pressing the yellow UP button.
3. Place the drum into the crushing chamber. Make sure the correct platen is installed for in-drum compaction.
4. Place material to be compacted into the drum. Make sure bags of waste have a hole punched in them for air release. Inspect metals for sharp edges or corners that may puncture the drum during compaction.
5. Close and latch the door.
6. Start the cycle by pressing the green AUTO/START button.
7. When the platen reaches the lowest point in the cycle, press the Red STOP button and wait 30-45 seconds before continuing the cycle by pressing the green AUTO/START button. This will help reduce spring-back of the compacted material.
8. At the end of the cycle, check the level of compacted material. If there is room for more, repeat steps d through g. If the drum is full, remove it from the crushing chamber.
9. At the end of crushing operations, press the red STOP button and lock in the OFF position.

7.2.5 General Operations - Drum Crushing

1. Turn on power to the machine.
2. Raise the platen by pressing the yellow UP button.
3. Make sure the drum plug is removed, or there is an air hole punched in the drum. Place the drum into the crushing chamber. Make sure the correct platen is installed for drum crushing.
4. Close and latch the door.
5. Start the cycle by pressing the green AUTO/START button.
6. At the end of the cycle, remove the crushed drum from the crushing chamber.
7. At the end of crushing operations, press the red STOP button and lock in the OFF position.

7.3 Maintenance and Inspection

7.3.1 All maintenance and inspections must be supervised by the Field Coordinator or designee. Before conducting any maintenance or inspection activities, make sure the power supply to the machine is turned off. Maintenance should be performed at the frequencies and manner specified in the Instruction Manual.

- Lubrication - Grease or oil the door hinges and door lock as required.
- Hydraulic System - Check the condition of the oil in the reservoir before each use and refill or replace as necessary. The oil level should be 2 in. from the reservoir top when the platen is up. Use mineral oil base only with anti-wear additives. Sunoco Sunvis 747, Shell L.D. Hydrak, and Gulf HVI-45 or 50 are all recommended. Check the pump strainer and the breather cap filter, and replace if necessary. Check for leaks and tighten all fittings as required.
- Mechanical - Check for loose connections and signs of wear with each use.
- Electrical - Check conduits and connections with each use.

8.0 DOCUMENTATION/RECORDS

None.

9.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

TASKMASTER HEAVY DUTY SOLIDS DISINTEGRATORN (SHREDDER) OPERATION AND SERVICING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE/SCOPE

This document provides instructions for the operation and servicing of the Taskmaster Heavy Duty Solids Disintegrator (Shredder), 1600 Series Models. This procedure describes the equipment and details the steps required to start, stop, and maintain efficient operation.

2.0 REFERENCES

2.1 *Project Health and Safety Plan*

2.2 *SOP 6.3 - Decontamination Procedures*

2.3 *Instruction Manual for Taskmaster 1600 Series Heavy Duty Solids Disintegrator*

3.0 ACRONYMS

3.1 H&S

Health and Safety

3.2 HWP

Hazardous Work Permit

3.3 HEPA

High Efficiency Particulate Air

4.0 RESPONSIBILITIES

4.1 Personnel

4.1.1 The Project Manager is responsible for the safe and effective implementation of this procedure.

4.1.2 The Field Coordinator is responsible for the equipment and the servicing of any particular part.

4.1.3 The Site Health and Safety Officer (SHSO) will ensure that the radiological safety and survey coverage is available before work is initiated. The SHSO is responsible for ensuring that operating/servicing personnel are properly trained in the radiological and industrial safety concerns/action applicable to work with this equipment.

4.1.4 The Radiological Control Technicians (RCTs) are responsible for conducting all radiation, contamination, and airborne surveys during the performance of this procedure.

4.1.5 Work personnel are responsible for performing the work outlined in this procedure in accordance with it's requirements and those of the applicable HWP.

5.0 SAFETY PRECAUTIONS

5.1 Maintenance

5.1.1 Before performing any maintenance procedure, be sure all power sources have been disconnected to avoid injury from shock and rotating parts.

5.1.2 Keep grease clean. Stop the motor before lubricating. Do not mix petroleum and silicone grease in the motor bearings.

5.1.3 Use only spare parts approved by engineering to ensure safe operation of the equipment.

5.2 Operation

5.2.1 Repeated unsuccessful attempts to restart the motor without clearing an obstruction in the Taskmaster Shredder can seriously damage or destroy the motor.

5.2.2 Noise levels produced by the Taskmaster Shredder will vary with the work application, and may require ear protection, as specified by the SHSO, to be worn by the operator and adjacent personnel. Monitoring of noise levels and hearing protection shall be in accordance with the PHSP (Reference 2.1), and as directed by the SHSO.

5.2.3 Face and eye protection is required at all times for the Taskmaster Shredder operator and adjacent personnel. This protection will either be a full faced respirator, safety glasses, and/or faceshield as specified by the SHSO. Leather work shoes will be required for the Taskmaster Shredder operator and adjacent personnel.

5.2.4 The Taskmaster Shredder will be used only in contamination control enclosures or building volumes which have HEPA-filtered exhaust systems. A HEPA vacuum shall be attached to the hopper so that when the lid is closed during operation, air flow will travel up through the shredder cutters and through the filter.

5.2.5 Air sampling for airborne radioactivity shall be conducted in the work areas during operation of the Taskmaster Shredder, in accordance with the PHSP (Reference 2.1), and as directed by the SHSO.

5.2.6 The number of people in the vicinity of an operating Taskmaster Shredder should be kept to a minimum as directed by the Field Coordinator.

5.2.7 The Taskmaster Shredder shall be used to reduce the size of fiberglass materials, HVAC gauge metals, and other materials of similar weight. No heavy gauge metals shall be placed into the shredder. No materials shall be placed into the shredder without prior approval of the Field Coordinator.

5.2.8 The Taskmaster Shredder is equipped with a safety interlock to prevent operation when the cover is open. If the safety interlock is not operational, the shredder shall not be used under any circumstances.

5.2.9 After final use, the shredder will be decontaminated in accordance with SOP 6.2 and the PHSP.

6.0 PREREQUISITES

Prior to operating the unit, verify that the equipment maintenance requirements are met as described in Section 7.4.

6.1 Personnel

6.1.1 Personnel shall understand and comply with HWP(s) and protective clothing requirements for drum shredder operations.

6.1.2 Personnel assigned to operate and service the Taskmaster Shredder will complete an applicable training program administered by H&S prior to performing work. The shredder will not be operated unless a trained operator is present. Documentation of shredder training shall be kept in the project files.

7.0 PROCEDURE

7.1 Equipment Description

The Taskmaster Shredder assembly consists of two main parts, the Taskmaster and the controller, which are connected by an electrical cable. The shredding action is accomplished by two counter rotating shafts with 3/4 in. cutting disks. The drive side shaft moves at a greater speed than the other shaft. After the material is shredded, it passes through a screen which retains larger sized materials for reprocessing. The motor to drive the Taskmaster is mounted to the reducer which is mounted to the shredder mechanism. Power is distributed from the hollow shaft reducer to the drive side shaft, through a gear coupling to the low speed shaft. The Taskmaster has a prelubricated ball bearing motor; therefore, no lubrication is necessary for initial start up.

7.2 Assembly and Disassembly

Detailed instructions for assembly and disassembly of the motor, reducer, fixed side cartridges, and expansion side cartridges are provided in Reference 2.5.

7.3 Operation

7.3.1 Initial Start-up Procedure

- Check to be sure that all bolts are securely fastened.
- Make sure the electrical hookup between the motor and the controller is complete, and that the motor is wired correctly.
- Turn the unit on.
- Run the Taskmaster Shredder for approximately one hour before feeding in material to be shredded.
- Check for unusual noises, vibrations, or heat buildup.
- Start the flow of material through the Taskmaster.

7.3.2 General Operation

- Check to be sure that all bolts are securely fastened.
- Make sure the electrical hookup between the motor and the controller is complete, and that the motor is wired correctly.
- Turn the unit on.
- Run the Taskmaster Shredder for approximately ten minutes before feeding in material to be shredded.
- Check for unusual noises, vibrations, or heat buildup.

- Start the flow of material through the Taskmaster.

7.4 Maintenance and Inspection

All maintenance and inspections must be supervised by the Field Coordinator or designee. Before conducting any maintenance or inspection activities, make sure the unit is turned off, and all power sources have been disconnected. Preventive maintenance of the Taskmaster should include lubrication and replacement of parts found to be worn or damaged upon disassembly. Maintenance operations shall be documented and kept in the project files.

7.4.1 Motor

- Under operating conditions at the LEHR Project, the motor should be lubricated every six months. The motor manufacturer recommends a polyuria type lubricant such as Shell Dolium R.
- Remove the lubrication fitting with equipment/materials which will not affect the mechanism or penetrate into the grease cavity.
- Weigh the grease gun or calibrate it to determine the delivery rate, and apply an appropriate amount of grease.
- Run the motor for 20 minutes before replacing the lubrication fitting.

7.4.2 Reducer

- Under operating conditions at the LEHR Project, the reducer oil will not require changing for two years, therefore, it is not anticipated that this maintenance operation will be required. Should information be required concerning changing of the reducer oil, the Instruction Manual should be consulted (Reference 2.5).

7.4.3 Bearings and Gear Train

- Under operating conditions at the LEHR Project, the bearings and gear train should be relubricated every six months. The bearings are prelubricated with medium consistency Dow Corning 44 High Temp Bearing Grease. The gear train is prelubricated with Petrolon Industrial Slick 50 EP Grease.
- To lubricate the bearings, remove the lubrication fitting and clean thoroughly with materials that will not affect the mechanism or penetrate into the grease cavity. Weigh or calibrate the grease gun, apply an appropriate amount of grease, and replace the lubrication fitting.
- To lubricate the gear train, remove the lubrication fitting and clean thoroughly with materials that will not affect the mechanism or penetrate into the grease cavity. Weigh or calibrate the grease gun, apply approximately 32 ounces of grease, and replace the lubrication fitting.

8.0 DOCUMENTATION/RECORDS

None.

9.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

LEAD CHARACTERIZATION, PACKAGING AND SHIPPING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes the methodology for the characterization, packaging and shipping for disposal of lead stored at the LEHR site. The work includes performing a radiological contact exposure rate survey of each drum of lead, selecting drums for representative sampling, obtaining representative samples of the lead from the drums, packaging samples for shipment for analysis, and shipping the lead for disposal. This procedure also describes the responsibilities of project personnel, health and safety considerations, references, and documentation requirements.

1.1 Work Activity

The work activity will consist of the following individual task items:

- Performing a contact dose rate survey of each drum to determine the number of drums that contain lead that is contaminated with radioactive materials.
- Segregating drums into groups containing bricks, shielding pigs, and pipe joints.
- Selecting a representative sample of the three separate groups for waste characterization sampling using the data from the drum contact survey.
- Obtaining representative samples of the three separate groups of material for Strontium-90 (Sr-90), isotopic thorium, isotopic uranium, and gamma isotopic analyses as applicable.
- Packaging the samples for shipment to the analytical laboratory.
- Packaging the drums for shipment for off-site disposal.
- Preparing the shipment manifest for shipment of the materials.
- Shipping of the drums from the LEHR site.

2.0 REFERENCES

2.1 *Project Health and Safety Plan*

2.2 *29 CFR 1910.1025, Lead*

2.3 *49 CFR 173, Shippers General Requirements for Shipment and Packagings*

2.4 *SOP 1.1 - Chain-of-Custody*

2.5 *SOP 25.1 - Radiological Surveys and Instrumentation*

2.6 *SOP 34.1 - Low Level Radioactive Waste Processing and Packaging*

2.7 *SOP 34.3 - Radioactive Waste Shipment*

3.0 RESPONSIBILITIES

3.1 Project Manager

The Project Manager is responsible for the safe and effective implementation of this procedure.

3.2 Radiological Controls Technician

The Radiological Controls Technician(s) (RCTs) are responsible for performing the contact dose rate survey of each drum.

3.3 Field Coordinator (FC)

The Field Coordinator (FC) is responsible for approving, coordinating, and supervising all field activities described in this procedure. The FC is directly responsible for ensuring the health and safety of all personnel and for conducting periodic inspections of the work site.

3.4 Field Technicians

Field Technicians are responsible for performing all lead sampling and handling work described in this procedure and the applicable HWP.

4.0 HEALTH AND SAFETY CONSIDERATIONS

Past operations at LEHR utilized lead in the form of bricks, shielding "pigs" and piping joints. Some of the lead was contaminated with radioactive materials during the course of the research work conducted at LEHR. Lead has been declared a hazardous material by the Environmental Protection Agency (EPA). The fact that some of the lead has been radiologically contaminated makes portions of the lead a potential mixed hazardous waste.

The Project Health and Safety Plan (PHSP) addresses the hazard analysis and hazard controls associated with waste handling activities. The following additional information will be considered when performing these tasks.

4.1 Industrial Safety Considerations

4.1.1 At a minimum, workers shall wear Level D PPE, including:

- Steel-toed boots;
- Safety glasses;
- Coveralls (when handling bare lead-contaminated materials); and,
- Gloves (when handling bare lead-contaminated materials).

4.1.2 Since sampling team members will be working with lead inside 55-gallon drums (lifting, stacking, and unbagging), there is a potential for musculo-skeletal stress. Workers should be aware of the awkward positions that will be required while working with the lead and review methods to reduce stresses by engineering or other means. Examples may be sitting on a stool or tipping the drum at an angle to allow greater ease of sampling.

4.1.3 Movement of loaded drums of lead will be done with drum carts or other devices that reduce the potential for worker injury from lifting heavy and awkward containers.

4.2 Radiological Considerations

Portions of the lead bricks are radiologically contaminated and thus represent a direct exposure and inhalation/skin contamination hazard from the gamma radiations emitted, and the loose radioactive contamination, respectively. At the present time all lead brick and pigs are sealed in Griflon bags. Hazardous Work Permit (HWP) requirements will be determined from the radiological contact surveys of all drums.

4.3 Chemical Safety Considerations

4.3.1 Elemental lead exposure is regulated by the Occupational Health and Safety Agency (OSHA) in 29 CFR 1910.1025 "Lead" (Reference 2) for occupational exposure. A permissible exposure limit (PEL) of 50 micrograms per cubic meter has been established for airborne lead. To preclude the possibility of airborne or dermal lead exposure, all sampling work will be performed within a secondary containment for the 55 gallon drums (glove bag, etc.).

4.3.2 Personnel will be required to wash their hands and face at each break where food and/or liquids may be consumed, and when leaving the site at the end of the shift.

4.4 Training

4.4.1 All personnel working on the lead sampling, packaging, shipping tasks associated with this procedure will have been trained in accordance with the requirements of the PHSP. This training will consist of having the Field Coordinator review:

- Content of lead standard 29 CFR 1910.1025;
- Specific nature of operations to be performed; and,
- Medical surveillance program.

4.4.2 At the beginning of each work day a tailgate safety meeting will be conducted and documented on the Tailgate Safety Meeting Form. As a minimum, the details of the expected work activities, site evacuation route(s), emergency actions, hazards associated with the sampling operations, and the requirements of the PHSP and the HWP will be discussed during the meeting.

5.0 PROCEDURE

The primary objective of the lead sampling activity will be to obtain representative samples of the lead contained in drums to allow for proper classification and waste manifesting prior to being shipped for final disposal. Secondary objectives of the lead sampling are to:

- Prevent personnel injuries during the project.
- Prevent unplanned releases of radioactive or hazardous materials.
- Prevent personnel contamination events during the project.
- Maintain personnel exposure ALARA.
- Minimize the generation of additional potentially mixed hazardous wastes during the project.

5.1 Pre-requisites

1. All workers have their training records on file at the LEHR site.
2. All personnel involved in the drum sampling have read the PHSP.
3. All tools will be safety inspected. Any tools that are not in good repair and operable will not be used.

4. Tools, materials, and waste containers required for the each days activities will be staged prior to starting work activities.
5. The lead sampling area will be posted.

5.2 Drum Sampling

5.2.1 All drums will be surveyed with a gamma dose rate meter to determine the radiological status of each drum. The highest contact reading obtained on each drum will be recorded on the survey log and the area marked on the drum where this reading was obtained identified. Radiological surveys will be performed in accordance with SOP 25.1, "Radiological Surveys and Instrumentation" (Reference 3).

5.2.2 Four of the drums will be selected for sampling. The drum selection criteria will be based on results of the dose rate surveys and should result in samples being collected that are representative of all the drums contents.

5.2.3 To sample a drum, a glove bag will be placed over the open drum and secured, the clamping ring will be loosened and removed, and the lid removed.

5.2.4 Several representative pieces of lead will be selected from each drum to be sampled. Two of the individually wrapped bricks will be segregated and stored for potential use during treatability studies. Pictures of various lead types, wrappings, and configurations will be taken to aid in planning for disposal. At a minimum, one piece of lead in six will be sampled and composited. In drums where elevated radiological readings are measured, the sampled lead will be biased to the area of the drum that exhibited the elevated reading. Each sample will consist of lead scrapings for radiological analysis. A 100-gram sample will be collected for radiological analysis with a draw knife.

5.2.5 Lead samples shall be packaged in glass jars, bagged and identified with a unique ID code that allows for identification of the sampled drum.

5.2.6 Once all sampling activities are completed in a drum, the drum lid will be replaced and the clamp ring secured. The glove bag will then be wiped down and sealed at the top of the drum. The bag will be collapsed using a vacuum cleaner and removed from the drum.

5.3 Sample Shipment and Analysis

5.3.1 Chain-of-Custody (COC) forms will be completed to track sample custody as well as to specify the requested analysis. COC forms will be completed in accordance with the requirements of SOP 1.1, "Chain-of-Custody" (Reference 4).

5.3.2 All samples sent off-site for analysis will be packaged and shipped according to the instructions provided by the analytical laboratory.

5.3.3 Samples will be analyzed for Sr-90, isotopic thorium, isotopic uranium, and gamma-emitting radionuclides at the analytical laboratory. Specific results will be used to calculate the total activity per drum of lead, taking into account the percent of the surface contaminated and the surface area of lead.

5.4 Drum Packaging and Shipping

5.4.1 Drums will be packaged and shipped in accordance with disposal site criteria, and following all applicable parts of 49 CFR.173, "Shippers General Requirements for Shipment and Packagings" (Reference 5), and facility procedures SOP 34.1, "Low Level Radioactive Waste Processing and Packaging" (Reference 6) and SOP 34.3, "Radioactive Waste Shipment" (Reference 7).

5.4.2 The transport tractor and trailer will be radiologically surveyed prior to the loading of any drums to ensure no loose or fixed contamination is present. Additionally, a safety inspection of the transport tractor and trailer will be made by the Field Coordinator, and any safety deficiencies found will be corrected prior to loading.

5.4.3 Four drums will be banded together on each pallet to prevent each drum from shifting during transport unless otherwise specified by disposal site criteria. Each pallet of drums will be placed in the transport trailer and positioned to minimize the movement of the pallets. The last row of pallets will be secured by cleats nailed to the trailer floor to prevent movement.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

CONTAMINATION CONTROL

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure provides requirements and guidelines for the control of radioactive contamination.

2.0 REFERENCES

2.1 *10 CFR 835, "Occupational Radiation Protection"*

2.2 *HSP 17.1, "Hazardous Work Permits"*

2.3 *HSP 18.1, "Personnel Contamination"*

2.4 *SOP 24.1, "Radiological Areas and Posting"*

2.5 *SOP 25.1, "Radiological Surveys and Instrumentation"*

2.6 *SOP 38.3, "Radiation Protection Records"*

2.7 *DOE Order 5400.5, "Radiation Protection of the Public and the Environment"*

3.0 DEFINITIONS

3.1 Controlled Area

Any area to which access is managed by or for DOE to protect individuals from exposure to radiation and/or radioactive material.

3.2 Radiological Buffer Area

An intermediate area established to prevent the spread of radioactive contamination and to protect personnel from radiation exposure.

3.3 Contamination

The presence of radioactivity in unwanted areas (i.e., surfaces of structures, objects, areas, or personnel).

3.4 Contamination Area

Any area, accessible to individuals, where removable surface contamination levels exceed or are likely to exceed the removable surface contamination values specified in Attachment 8.1, but do not exceed 100 times those values.

3.5 Hazardous Work Permit (HWP)

A document issued by the Radiological Control Manager (RCM) which establishes administrative and physical controls and limits for work performed in hazardous or controlled areas.

4.0 RESPONSIBILITIES

4.1 Project Manager (PM)

The PM is responsible for the safe and effective implementation of this procedure.

4.2 Radiological Control Manager(RCM)

The RCM is responsible for ensuring all field activities are performed in compliance with this procedure.

4.3 Radiation Safety Officer (RSO)

The RSO is responsible for ensuring that all Radiological Control technicians are properly trained on this procedure.

4.4 Radiological Control Technicians (RCTs)

RCTs are responsible for the implementation of this procedure.

4.5 Radiological Workers

Radiological Workers are responsible for performing the work outlined in this procedure in accordance with its requirements and those of the applicable HWP.

5.0 SAFETY PRECAUTIONS/PREREQUISITES

- Personnel engaging in contamination control activities shall be aware of the radiological and hazardous conditions of the work area.
- Personnel will wear the appropriate personnel protective equipment.
- An HWP will be approved and understood by all personnel prior to engaging in contamination control activities.
- All survey instrumentation shall have a current calibration, and be source and background checked on the day of use, and be visually inspected prior to use.

6.0 PROCEDURE

6.1 Contamination Limits and Control

6.1.1 Personnel, equipment, and facilities are considered contaminated if the amount of radioactive material exceeds the values specified in Appendix D of 10 CFR 835 (Reference 2.1).

6.1.2 Instruments and techniques used for radioactive contamination monitoring and control shall be adequate to ensure compliance with 10 CFR 835.

6.1.3 Appropriate controls shall be maintained and verified which prevent the inadvertent transfer of removable contamination to locations outside of radiological areas under normal operating conditions.

6.1.4 Any area in which contamination levels exceed the values specified in Appendix D of 10 CFR 835 shall be controlled in a manner commensurate with the physical and chemical characteristics of the contaminant, the radionuclides present, and the fixed and removable contamination levels.

6.1.5 Areas with fixed contamination exceeding the total radioactivity values specified in Appendix D of 10 CFR 835 may be located outside of radiological areas provided the following conditions are met:

- Removable contamination levels are below the levels specified in Appendix D of 10 CFR 835;
- Unrestricted access to the area is not likely to cause any individual to receive a total effective dose equivalent in excess of 0.1 rem in a year;
- The areas is routinely monitored;
- The areas is clearly marked to alert personnel of the contaminated status;

- Appropriate administrative procedures are established and exercised to maintain control of these areas; and,
- Dose rates do not exceed levels which would require posting in accordance with Section 835.603.

6.1.6 Appropriate monitoring (whole body frisking) to detect and prevent the spread of contamination shall be performed by individuals exiting radiological areas established to control removable contamination and/or airborne radioactivity.

6.1.7 Periodic surveys shall be conducted to ensure the removable surface contamination remains fixed to the surface and below limits set in Appendix D, 10 CFR 835.

6.2 Tagging and Posting

6.2.1 Contaminated areas shall be posted in accordance with SOP 24.1, *Radiological Areas and Posting* (Reference 2.4) when contamination levels exceed the values specified in Appendix D of 10 CFR 835.

6.2.2 All contaminated items that are not in a posted contamination area shall be tagged. The tag shall contain information on extent and type of contamination. An example is shown as Attachment 2.

6.2.3 Only Radiological Control Technicians shall post and tag or remove postings and tags.

6.3 Protection of Personnel, Equipment, and Areas

Administrative and engineering controls shall be used to minimize the potential for the spread of contamination. Administrative controls may consist of access restrictions and posting of contaminated areas. Engineering controls may consist of containment enclosures, HEPA filtered ventilation, and physical barriers. The checklist provided as Attachment 4 “Checklist for Reducing Occupational Radiation Exposure”, may be used to aid in work planning.

6.3.1 Protection of Personnel

- Personnel shall wear personal protective equipment (PPE) whenever they are in contaminated areas. PPE may include shoe covers, boots, coveralls, hood, gloves, faceshield, etc.
- PPE shall be specified only by a Hazardous Work Permit (HWP) (Reference 2.3).
- Protective clothing shall be required for entry to areas in which removable contamination exists at levels exceeding those specified in Appendix D to 10 CFR 835.
- Personnel entry control shall be maintained for each radiological area.

- The degree of (personnel entry) control shall be commensurate with existing and potential radiological hazards within the area.
- One or more of the following methods shall be used to ensure (personnel entry) control:
    1. Signs and barricades;
    2. Control devices on entrances;
    3. Conspicuous visual and/or audible alarms;
    4. Locked entrance ways; or,
    5. Administrative controls.
- Administrative procedures shall be written as necessary to demonstrate compliance with the provisions of this section, if not covered in the available HSPs/SOPs.
- These administrative procedures shall include actions essential to ensure the effectiveness and operability of barricades, devices, alarms, and locks.
- Authorizations shall be required to perform specific work within the area and shall include specific radiation protection measures.
- No control(s) shall be installed at any radiological areas exit that would prevent rapid evacuation of personnel under emergency conditions.
- Guidelines for contamination control practices that include donning and removal of PPE (e.g. full set) are contained in Attachment 3.
- PPE used may have residual, fixed contamination present. The use of PPE having residual, fixed contamination will be reviewed and approved by the RSO on a case-by-case basis. The limits on contamination for reuse of PPE are:

    - 1000 dpm/100 cm^2 alpha
    - 15000 dpm/100 cm^2 beta-gamma.
- Physical barriers shall be set up such that they do not impede the intended use of emergency exits or evacuation routes.
- Physical access controls for high and very high radiation areas are provided as Attachment 5.
- Personnel shall wear protective clothing during work in Contamination and High Contamination Areas and should wear protective clothing during the following activities:
    - Handling of contaminated materials with removable contamination in excess of Appendix D, 10 CFR 835 levels;
    - Work in Airborne Radioactivity Areas;
    - As directed by the Radiological Control Organization or as required by the HWP; and,

- Written authorizations shall be required to control entry into and perform work within radiological areas. These authorizations shall specify radiation protection measures commensurate with the existing and potential hazards.

6.3.2 Protection of Equipment

- Material that is to enter a contaminated area shall be protected to minimize the potential for contamination. This may include bagging, taping, etc.
- Material that can not be protected from becoming contaminated shall be treated in a manner to facilitate decontamination whenever possible. These measures include painting, strip coating or polishing.

6.3.3 Protection of Areas

- Any equipment outside of a contamination area that has removable contamination on it shall be bagged, wrapped, taped, etc. to prevent contamination from spreading, and the equipment and bag shall be tagged.
- Contaminated equipment shall be stored in designated storage areas. These areas should be approved prior to use by RCTs.
- Storage areas shall be protected to prevent them from becoming contaminated. This includes use of floor coverings, other physical barriers, etc.
- Storage areas could also be treated to the extent practicable to allow decontamination. This includes painting, sealing concrete, etc.

6.4 Ingress/Egress of Contaminated Areas

All ingress/egress points shall be maintained in compliance with this procedure.

6.4.1 Contamination areas shall be demarcated such that ingress/egress are through designated points.

6.4.2 Where possible, one way traffic flow in contamination areas should be encouraged.

6.4.3 Ingress/egress points should be located in low contamination areas.

6.4.4 Workers shall remove all PPE except inner gloves and shoe covers in the contamination area when leaving. PPE shall be placed in designated receptacles at the egress point.

6.4.5 Egress points should have a step-off pad or sticky pad outside the exit point, contiguous with the area boundary. Gloves and shoe covers are removed at this point prior to stepping onto the step-off pad.

6.4.6 Personnel shall frisk themselves for contamination immediately upon leaving a contaminated area. The frisking should cover the areas protected by PPE. If personnel are contaminated they shall remain where they are and call the RCT for assistance. Frisking instructions, including required actions if contamination is detected, will be posted at each frisking station. Personnel decontamination and reporting shall be conducted in accordance with HSP-18.1, "Personnel Contamination,"(Reference 2.3). Guidelines for personnel contamination monitoring are provided as Attachment 6.

If an RCT is not present, the individual can isolate the contaminated area using tape, plastic bags, etc. and then proceed to the RSO office for assistance.

6.4.7 Friskers shall be located as close to egress points as background radiation levels allow.

6.4.8 Items shall be surveyed by RCTs when leaving the contaminated area.

6.4.9 The following practices are forbidden within a radiologically controlled (controlled) area:

- Smoking or other use of tobacco.
- Eating, drinking, or gum chewing.
- Wearing contact lenses.
- Entering a controlled area without having the required training.
- Entering a controlled area without having read and signed in on the HWP appropriate for the task.
- Entering a controlled area without proper protective clothing, improperly using PPE, or with faulty equipment.
- Exiting a controlled area without properly frisking.
- Performing tasks outside the scope of the HWP.
- Other practices identified in the HWP.

These restrictions shall be posted at the entrances to controlled areas or otherwise communicated to site workforce.

6.4.10 Entry control and posting are not required for areas with fixed contamination meeting the conditions of Appendix D, 10 CFR 835.

6.4.11 Physical controls for high and very high radiation areas are presented as Attachment 5.

6.5 Identification of Contaminated Areas and Equipment

In addition to the tagging and posting requirements, contaminated areas and equipment are identified through association with the colors yellow and magenta. Contaminated equipment should be bagged or wrapped in materials that are yellow. All contamination area postings shall be in accordance with SOP-24.1, *Radiological Areas and Postings* (Reference 2.4).

6.6 Surveillance of Contaminated and Clean Areas

6.6.1 A surveillance program shall be initiated to routinely survey controlled areas for contamination. Surveys shall be performed in accordance to the minimum frequency presented in SOP-25.1, "Radiological Surveys and Instrumentation," (Reference 2.5). However, changing conditions and operations may require increased frequencies as directed by the RSO or the judgement of the RCT.

6.6.2 The surveillance program shall be prescribed by the RCM.

6.7 Release of Materials and Equipment from Radiological Areas

The following requirements apply for the release of materials and equipment from radiological areas for use in controlled areas.

6.7.1 In radiological areas established to control surface or airborne radioactive material, material and equipment shall be treated as radioactive material and shall not be released from radiological areas to controlled areas if either of the following conditions exist:

- Measurements of accessible surfaces from contamination, high contamination or airborne radioactivity areas show that either the total or removable contamination levels upon survey exceed the values specified in Appendix D, 10 CFR 835; or,
- Prior use suggests that the contamination levels on inaccessible surfaces are likely to exceed the values specified in Appendix D to this part.

6.7.2 Material and equipment exceeding the total or removable contamination levels specified in Appendix D to this part may be conditionally released for movement on-site from one radiological area for immediate placement in another radiological area only if appropriate monitoring and control procedures are established and exercised. These items shall be routinely monitored, labeled, and controlled in accordance with written procedures.

6.7.3 Material and equipment with fixed contamination levels that exceed the limits specified in Appendix D to this part may be released for use in controlled areas outside of the radiological areas with the following provisions:

- Removable contamination levels shall be below the level specified in Appendix D of this part;
- Materials shall be routinely monitored, clearly labeled, or tagged to alert personnel of the contaminated status;
- appropriate administrative procedures shall be established and exercised to maintain control of these items; and,
- Disassembly to the extent necessary shall be performed to do an adequate survey.

6.7.4 The records for release of material and equipment shall describe the property, date on which the release survey was performed, identity of the individual who performed the survey, type and identification number of the survey instrument used, and results of the survey.

6.7.5 Radiological labeling shall be removed from or defaced on non-radioactive materials prior to release from radiological areas.

6.8 Stop Radiological Work Authority

Radiological Control Technicians and their supervisors, line supervision, and any worker through their supervisor shall have the authority and responsibility to stop radiological work activities for any of the following reasons [see DOE 440.1.7]:

- Inadequate radiological controls;
- Radiological controls not being implemented; or,
- Radiological Control Hold Point not being satisfied.

6.9 Transportation of Radioactive Material

6.9.1 10 CFR 835.1 excludes radioactive material transportation activities that are performed in compliance with applicable DOE Orders from the requirements of 10 CFR 835. However, radioactive material transportation does not include preparation of materials for shipment, packaging and labeling, or performance of surveys required for occupational radiation protection. Therefore, these activities shall be conducted in accordance with 10 CFR 835.

6.9.2 On-site transfers over nonpublic thoroughfares or between facilities on the same site should be performed in accordance with written procedures utilizing pre-approved routes. The procedures or other measures shall include requirements to ensure appropriate monitoring and control of the radioactive material.

6.9.3 On-site transfers over public thoroughfares by non-DOE conveyance shall be performed in accordance with Department of Transportation, state, and local shipping requirements and pre-approved agreements. Onsite transfers over public thoroughfares by DOE conveyance shall be performed in accordance with applicable DOE Orders and should conform with state and local shipping requirements and pre-approved agreements.

6.9.4 Specific arrangements shall be made for receiving packages containing radioactive material, regardless of the means of conveyance, in excess of Type A quantities (as defined in 10 CFR 71.4). These arrangements shall include:

- Making arrangements to receive packages upon delivery or to receive notification of delivery which leads to expeditious receipt of the package;
- Receive notification as soon as practical after arrival of the package and to take possession of the package expeditiously after receiving such notification; and,

- Development and maintenance of written procedures for safely opening packages with due consideration of the type of package and potential hazards present.

6.10 Radioactive Source Controls

Sealed radioactive sources having activities equal to or exceeding the values specified in SOP 24.1, Attachment 2, are considered accountable sealed sources and are subject to the controls established below and shall be used, handled, and stored in a manner commensurate with the hazards associated with operations involving the sources.

6.10.1 Written procedures shall be established and implemented to control accountable sealed radioactive sources. These procedures should establish requirements for source acquisition, receipt, storage, transfer, inventory, leak testing, and usage.

6.10.2 Accountable sealed sources, or their storage containers shall be labeled with the radiation symbol and "CAUTION" or "DANGER RADIOACTIVE MATERIAL". The label shall also provide sufficient information to minimize exposures, such as the radionuclide, the quantity of radioactive material, and the date of quantity estimate. However, such labels are exempt from the normal color scheme of magenta or black on yellow. If the size or configuration of the source precludes application of a suitable label, the label should be attached to the source container or mechanism.

6.10.3 Each accountable sealed radioactive source shall be inventoried at intervals not to exceed six months. This inventory shall:

1. Establish the physical location of each accountable sealed radioactive source;
2. Verify that the associated posting and labeling are adequate; and,
3. Establish that storage locations, containers, and devices are adequate.

6.10.4 Each accountable sealed radioactive source having an activity in excess of 0.005 µCi shall be subject to a source leak test upon receipt, when damage is suspected and at intervals not to exceed six months. Source leak tests shall be capable of detecting radioactive material leakage equal to or exceeding 0.005 µCi.

6.10.5 Periodic leak tests need not be performed if the source has been documented to have been removed from service. Such sources shall be stored in a controlled location and subject to periodic inventory and subject to leak testing prior to being returned to service.

6.10.6 If a source is located in an area that is unsafe for human entry (such as due to operational or environmental constraints), then periodic inventories and leak tests need not be performed. When the conditions that restrict access to the area have been terminated, the inventory and leak test should be performed before allowing uncontrolled access to the area.

6.10.7 If an accountable sealed radioactive source is found to be leaking radioactive material at a level exceeding 0.005 µCi, then controls shall be established to prevent the escape of radioactive material to the workplace. These controls should include wrapping or containing the source, applying appropriate labels, and removing the source from service.

6.10.8 Procurement of radioactive sources should be coordinated with the RCM and RSO

6.10.9 Receipt surveys of radioactive material shipments should be performed by the RCTs.

6.10.10 Sealed radioactive sources, including radiography sources, should not be brought on-site by external organizations without the prior knowledge and approval of the RSO.

6.10.11 Items and containers may be excepted from the radioactive material labeling requirements of § 835.605 when:

- Used, handled, or stored in areas posted and controlled in accordance with this subpart and sufficient information is provided to permit individuals to take precautions to avoid or control exposures; or
- The quantity of radioactive material is less than one tenth of the values specified in appendix E of this part; or
- Packaged, labeled, and marked in accordance with the regulations of the Department of Transportation or DOE Orders governing radioactive material transportation; or
- Inaccessible, or accessible only to individuals authorized to handle or use them, or to work in the vicinity; or
- Installed in manufacturing, process, or other equipment, such as reactor components, piping, and tanks; or
- The radioactive material consists solely of nuclear weapons or their components.

Radioactive material labels applied to sealed radioactive sources may be excepted from the color specifications of § 835.601(a).

6.11 Solid Radioactive Waste Management

6.11.1 Requirements

- DOE 5820.2A describes how solid radioactive waste is treated, packaged, stored, transported, and disposed;
- Radiological operations generating radioactive waste shall be designed and developed to promote minimization and permit segregation, monitoring, treatment, storage, and disposal; and,
- Radioactive waste minimization goals and practices shall be developed and implemented [DOE 5820.2A].

6.11.2 Waste Minimization

A radioactive waste minimization program shall be in effect to reduce the generation of radioactive waste and spread of contamination from Contamination, High Contamination, or Airborne Radioactivity Areas [see DOE 5820.2A].

7.0 RECORDS

Survey results are to be maintained as required by SOP 38.3 (Reference 6).

8.0 ATTACHMENTS

8.1 *Surface Residual Radioactivity Guidelines*

8.2 *Sample Contamination Tag*

8.3 *Guidelines for Contamination Control Practices*

8.4 *Checklist for Reducing Occupational Radiation Exposure*

8.5 *Physical Access Controls for High and Very High Radiation Areas*

8.6 *Guidelines for Personnel Contamination Monitoring with Hand Held Instruments*

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 8.1

SURFACE RESIDUAL RADIOACTIVE GUIDELINES

Attachment 8-1. Surface Contamination Values[1] in dpm/100 cm^2

Radionuclide	Removable [2,4]	Total (Fixed + Removable)[2,3]
U-nat, U-235, U-238, and associated decay products	[7] 1,000	[7] 5,000
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	500
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above[5]	1,000	5,000
Tritium and tritiated compounds[6]	10,000	N/A

[1] The values in this appendix, with the exception noted in footnote 5 below, apply to radioactive contamination deposited on, but not incorporated into the interior or matrix of, the contaminated item. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides apply independently.

[2] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[3] The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the value specified. For purposes of averaging, any square meter of surface shall be considered to be above the surface contamination value if: (1) from measurements of a representative number of sections it is determined that the average contamination level exceeds the applicable value; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds three times the applicable value.

[4] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper, applying moderate pressure, and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area shall be based on the actual area and the entire surface shall be wiped. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

[5] This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched.

[6] Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface contamination value provided in this appendix is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply.

[7] (alpha)

ATTACHMENT 8.2

SAMPLE CONTAMINATION TAG

GUIDELINES FOR CONTAMINATION CONTROL PRACTICES

Selection of Protective Clothing (PC)

1. Workers should inspect protective clothing prior to use for tears, holes, or split seams that would diminish protection. Any defective items should be replaced with intact protective clothing.

2. Protective clothing as prescribed by Hazardous Work Permit should be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, and regard for nonradiological hazards that may be present. Table 8.3-1 provides general guidelines for selection. As referenced in the table, a full set and double set of protective clothing typically includes:

   Full Set of PCs

   a. Coveralls
   b. Cotton glove liners
   c. Gloves
   d. Shoe covers
   e. Rubber overshoes
   f. Hood

   Double Set of PCs

   a. Two pairs of coveralls
   b. Cotton glove liners
   c. Two pairs of gloves
   d. Two pairs of shoe covers
   e. Rubber overshoes
   f. Hood

3. Cotton glove liners may be worn inside standard gloves for comfort, but should not be worn alone or considered as a layer of protection.

4. Shoecovers and gloves should be sufficiently durable for the intended use. Leather or canvas work gloves should be worn in lieu of or in addition to standard gloves for work activities requiring additional strength or abrasion resistance.

5. Use of industrial safety equipment, such as hard hats, in Contamination, High Contamination, and Airborne Radioactivity Areas should be controlled by the Hazardous Work Permit. Reusable industrial safety equipment designated for use in such areas should be distinctly colored or marked.

6. Shoe covers and gloves should be secured or taped at the coverall legs and sleeves when necessary to prevent worker contamination. Tape should be tabbed to permit easy removal.

7. Supplemental pocket or electronic dosimeters should be worn outside the protective clothing, in a manner accessible to the worker. Workers should protect such dosimeters from contamination by placing them in an outer coverall pocket or in plastic bags or pouches.

8. Outer personal clothing should not be worn under protective clothing for entry to High Contamination Areas or during work conditions requiring a double set of protective clothing.

Removal of Protective Clothing

Potentially contaminated protective clothing should be removed without spreading contamination and in particular without contaminating the skin. Workers should be instructed not to touch the skin or place anything in the mouth during protective clothing removal.

Recommended Sequence for Removing a Full Set of Protective Clothing at the Step-Off Pad

Before stepping out of the Contamination Area or Airborne Radioactivity Area to the step-off pad, the worker should:

1. Remove exposed tape;
2. Remove rubber overshoes;
3. Remove gloves;
4. Remove hood from front to rear;
5. Remove respiratory protection, as applicable;
6. Remove coveralls, inside out, touching inside only;
7. Take down barrier closure, as applicable;
8. Remove tape or fastener from inner shoe cover;
9. Remove each shoe cover, placing shoe onto clean step-off pad;
10. Remove cloth glove liners;
11. Replace barrier closure, as applicable;
12. Commence whole body frisking; and
13. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry is dependent upon where the dosimetry was worn and the potential for contamination.

Recommended Sequence for Removing a Double Set of Protective Clothing using Two Step-Off Pads

Before stepping to the inner step-off pad, the worker should:

1. Remove exposed tape;
2. Remove rubber overshoes;
3. Remover outer gloves;
4. Remove hood from front to rear;
5. Remove respiratory protection, as applicable;
6. Remove outer coverall, inside out, touching inside only;
7. Remove tape from inner coverall and sleeves; and,
8. Remove each outer shoe cover, stepping on inner step-off pad as each is removed.

Before stepping to the outer step-off pad, the worker should:

9. Remove inner rubber gloves;
10. Remove inner coveralls, inside out, touching inside only;
11. Take down barrier closure, as applicable;
12. Remove tape or fastener from inner shoe cover;
13. Remove each inner shoe cover, placing shoe on clean outer step-off pad;
14. Remove cotton glove liners;
15. Replace barrier closure, as applicable;
16. Commence whole body frisking; and,
17. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry is dependent upon where the dosimetry was worn and the potential for contamination.

Use of Multiple Step-Off Pads

1. Multiple step-off pads should be used to control exit from High Contamination Areas. These pads define interim control measures within the posted area to limit the spread of contamination. The following controls apply:

   a. The inner step-off pad should be located immediately outside the highly contaminated work area, but still within the posted area;
   b. The worker should remove highly contaminated outer clothing prior to stepping on the inner step-off pad;
   c. Additional secondary step-off pads, still within the posted area, may be utilized as necessary to restrict the spread of contamination out of the immediate area; and,
   d. The final or outer step-off pad should be located immediately outside the Contamination Area.

Table 8.3-1. Guidelines for Selecting Protective Clothing (PC)

	REMOVABLE CONTAMINATION LEVELS	**WORK ACTIVITY**	**LOW** (1 to 10 times 10 CFR 835, Appendix D values)
MODERATE (10 to 100 times 10 CFR 835, Appendix D values)	**HIGH** (> 100 times 10 CFR 835, Appendix D values)	Routine	Full set of PCs
Full set of PCs	Full set of PCs, double gloves, double shoecovers	Heavy work	Full set of PCs, work gloves
Double set of PCs, work gloves	Double set of PCs, work gloves	Work with pressurized or large volume liquids, closed system breach	Full set of non-permeable PCs
Double set of PCs (outer set non-permeable), rubber boots	Double set of PCs and non-permeable outer clothing, rubber boots		

Note:

For hands-off tours or inspections in areas with removable contamination at levels 1 to 10 times the values in Appendix D, 10 CFR 835, labcoats, shoecovers, and gloves may be used instead of full PCs.

ATTACHMENT 8.3

GUIDELINES FOR CONTAMINATION CONTROL PRACTICES

ATTACHMENT 8.3

GUIDELINES FOR CONTAMINATION CONTROL PRACTICES

Selection of Protective Clothing (PC)

1. Workers should inspect protective clothing prior to use for tears, holes, or split seams that would diminish protection. Any defective items should be replaced with intact protective clothing.

2. Protective clothing as prescribed by the Radiological Work Permit should be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, and regard for nonradiological hazards that may be present. Table 3-1 provides general guidelines for selection. As referenced in the table, a full set and double set of protective clothing typically includes:

Full Set of PCs

a. Coveralls

b. Cotton glove liners

c. Gloves

d. Shoe covers

e. Rubber overshoes

f. Hood

Double Set of PCs

a. Two pairs of coveralls

b. Cotton glove liners

c. Two pairs of gloves

d. Two pairs of shoe covers

e. Rubber overshoes

f. Hood

3. Cotton glove liners may be worn inside standard gloves for comfort, but should not be worn alone or considered as a layer of protection.

4. Shoecovers and gloves should be sufficiently durable for the intended use. Leather or canvas work gloves should be worn in lieu of or in addition to standard gloves for work activities requiring additional strength or abrasion resistance.

5. Use of industrial safety equipment, such as hard hats, in Contamination, High Contamination, and Airborne Radioactivity Areas should be controlled by the Radiological Work Permit. Reusable industrial safety equipment designated for use in such areas should be distinctly colored or marked.

6. Shoe covers and gloves should be secured or taped at the coverall legs and sleeves when necessary to prevent worker contamination. Tape should be tabbed to permit easy removal.

7. Supplemental pocket or electronic dosimeters should be worn outside the protective clothing, in a manner accessible to the worker. Workers should protect such dosimeters from contamination by placing them in an outer coverall pocket or in plastic bags or pouches.

8. Outer personal clothing should not be worn under protective clothing for entry to High Contamination Areas or during work conditions requiring a double set of protective clothing.

Removal of Protective Clothing

Potentially contaminated protective clothing should be removed without spreading contamination and in particular without contaminating the skin. Workers should be instructed not to touch the skin or place anything in the mouth during protective clothing removal.

Recommended Sequence for Removing a Full Set of Protective Clothing at the Step-Off Pad Before stepping out of the Contamination Area or Airborne Radioactivity Area to the step-off pad, the worker should:

1. Remove exposed tape

2. Remove rubber overshoes

3. Remove gloves

4. Remove hood from front to rear

5. Remove respiratory protection, as applicable

6. Remove coveralls, inside out, touching inside only

7. Take down barrier closure, as applicable

8. Remove tape or fastener from inner shoe cover

9. Remove each shoe cover, placing shoe onto clean step-off pad

10. Remove cloth glove liners

11. Replace barrier closure, as applicable

12. Commence whole body frisking

13. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry is dependent upon where the dosimetry was worn and the potential for contamination.

Recommended Sequence for Removing a Double Set of Protective Clothing using Two Step-Off Pads

Before stepping to the inner step-off pad, the worker should:

1. Remove exposed tape

2. Remove rubber overshoes

3. Remover outer gloves

4. Remove hood from front to rear

5. Remove respiratory protection, as applicable

6. Remove outer coverall, inside out, touching inside only

7. Remove tape from inner coverall and sleeves

8. Remove each outer shoe cover, stepping on inner step-off pad as each is removed.

Before stepping to the outer step-off pad, the worker should:

9. Remove inner rubber gloves

10. Remove inner coveralls, inside out, touching inside only

11. Take down barrier closure, as applicable

12. Remove tape or fastener from inner shoe cover

13. Remove each inner shoe cover, placing shoe on clean outer step-off pad

14. Remove cotton glove liners

15. Replace barrier closure, as applicable

16. Commence whole body frisking

17. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry is dependent upon where the dosimetry was worn and the potential for contamination.

Use of Multiple Step-Off Pads

1. Multiple step-off pads should be used to control exit from High Contamination Areas. These pads define interim control measures within the posted area to limit the spread of contamination. The following controls apply:

a. The inner step-off pad should be located immediately outside the highly contaminated work area, but still within the posted area

b. The worker should remove highly contaminated outer clothing prior to stepping on the inner step-off pad

c. Additional secondary step-off pads, still within the posted area, may be utilized as necessary to restrict the spread of contamination out of the immediate area

d. The final or outer step-off pad should be located immediately outside the Contamination Area.

Table 3-2 Guidelines for Selecting Protective Clothing (PC)	REMOVABLE WORK LOW	CONTAMINATION ACTIVITY (1 to 10 times Table 2-2	LEVELS values)
MODERATE HIGH Routine Full set of PCs	(10 to 100 times (> 100 times Table 2-2	Table 2-2 values) values)	Full set of PCs Full set of PCs, double Heavy work Full set of PCs, work
gloves, double gloves	shoecovers	Double set of Double set of PCs, Work with pressurized Full set of	PCs, work gloves work gloves or large volume non-permeable PCs
liquids, closed system	breach	Double set of PCs Double set of PCs and	(outer set non- non-permeable outer
permeable), clothing, rubber boots	rubber boots	Note:	For hands-off tours or inspections in areas with removable contamination at levels 1 to 10 times the values in Table 2-2, labcoats,
shoecovers, and gloves may be used instead of full PCs.			

ATTACHMENT 8.4

CHECKLIST FOR REDUCING OCCUPATIONAL RADIATION EXPOSURE

CHECKLIST FOR
REDUCING OCCUPATIONAL RADIATION EXPOSURE

Preliminary Planning and Scheduling

- Plan in advance
- Delete unnecessary work
- Determine expected radiation levels
- Estimate collective dose
- Sequence jobs
- Schedule work
- Select a trained and experienced work force
- Identify and coordinate resource requirements

Preparation of Technical Work Documents

Include special radiological control requirements in technical work documents
Perform ALARA pre-job review
Plan access to and exit from the work area
Provide for service lines (air, welding, ventilation)
Provide communication (sometimes includes closed-circuit television)
Remove or shield sources of radiation
Plan for installation of temporary shielding
Decontaminate
Work in lowest radiation levels
Perform as much work as practicable outside radiation areas
State requirements for standard tools
Consider special tools, including robots
State staging requirements for materials, parts and tools
Incorporate Radiological Control Hold Points
Minimize discomfort of workers
Revise estimates of person-rem
Prepare Hazardous Work Permits (HWPs)

Temporary Shielding

- Design shielding to include stress considerations
- Control installation and removal by written procedure
- Inspect after installation
- Conduct periodic radiation surveys
- Prevent damage caused by heavy lead temporary shielding
- Balance radiation exposure received in installation against exposure saved by installation
- Shield travel routes
- Shield components with abnormally high radiation levels early in the maintenance period
- Shield position occupied by worker
- Perform directional surveys to improve design of shielding by locating source of radiation
- Use mock-ups to plan temporary shielding design and installation
- Consider use of water-filled shielding

Rehearsing and Briefing

- Rehearse
- Use mock-ups duplicating working conditions
- Use photographs and videotapes
- Supervisors conduct briefings of workers

Performing Work

- Comply with technical work documents and HWPs
- Post radiation levels
- Keep excess personnel out of radiation areas
- Minimize radiation exposure
- Supervisors and workers keep track of radiation exposure
- Workers assist in radiation and radioactivity measurements
- Delegate radiological control monitoring responsibilities
- Evaluate use of fewer workers
- Reevaluate reducing radiation exposures
- Compare actual collective dose against pre-job estimate
- Review work practices to see if changes will reduce dose
- Coordinate personnel at the job site to reduce nonproductive time

ATTACHMENT 8.5

PHYSICAL ACCESS CONTROLS FOR HIGH AND VERY HIGH RADIATION AREAS

PHYSICAL ACCESS CONTROLS
FOR HIGH AND VERY HIGH RADIATION AREAS

One or more of the following features should be used for each entrance or access point to a High Radiation Area and shall be used for each entrance or access point to a High Radiation Area where radiation levels exist such that an individual could exceed a whole body dose of 1 rem in any one hour:

- A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below that level defining a High Radiation Area;
- A device that functions automatically to prevent use or operation of the radiation source or field while personnel are in the area;
- A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the High Radiation Area and the supervisor of the activity are made aware of the entry;
- Entryways that are locked, except during periods when access to the area is required, with positive control over each entry;
- Continuous direct or electronic surveillance that is capable of preventing unauthorized entry; and,
- A control device that automatically generates audible and visual alarm signals to alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area or activation of a secondary control device that will prevent use or operation of the source.

In addition to the above requirements, additional measures shall be implemented to ensure personnel are not able to gain access to Very High Radiation Areas.

Physical access controls over High and Very High Radiation Areas shall be established in a manner that does not prevent an individual from leaving the area.

ATTACHMENT 8.6

GUIDELINES FOR PERSONNEL
CONTAMINATIONMONITORING
WITH HAND HELD INSTRUMENTS

GUIDELINES FOR PERSONNEL CONTAMINATION MONITORING WITH HAND-HELD SURVEY INSTRUMENTS

General Requirements

1. Verify that the instrument is in service, set to the proper scale, and the audio output can be heard during frisking.
2. Hold probe less than 1/2 inch from surface being surveyed for beta and gamma contamination, approximately 1/4 inch for alpha contamination.
3. Move probe slowly over surface, approximately 2 inches per second.
4. If the count rate increases during frisking, pause for 5 to 10 seconds over the area to provide adequate time for instrument response.
5. If the count rate increases to a value greater than a pre-established contamination limit or the instrument alarms, remain in the area and notify Radiological Control personnel.
6. The whole body frisk should take at least two to three minutes.

Performance of Monitoring:

1. Frisk the hands before picking up the probe.
2. Perform the frisk in the following order:
   a. Head (pause at mouth and nose for approximately 5 seconds)
   b. Neck and shoulders
   c. Arms (pause at each elbow for approximately 5 seconds)
   d. Chest and abdomen
   e. Back, hips and seat of pants
   f. Legs (pause at each knee for approximately 5 seconds)
   g. Shoe tops
   h. Shoe bottoms (pause at sole and heel for approximately 5 seconds)
   i. Personnel and supplemental dosimeters.
3. Return the probe to its holder and leave the area. The probe should be placed on the side or face up to allow the next individual to monitor their hands before handling the probe.

WASTE PROCESSING AND PACKAGING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure applies to processing, packaging, and documentation activities required to prepare LEHR wastes for transport and disposal in accordance with the LEHR Waste Certification Plan and Procedure SOP-35.1 (References 2.1 and 2.2). Wastes included in the scope of this procedure are Low-Level Radioactive Waste (LLW), Hazardous Waste (HW), and Radioactive Mixed Waste (RMW).

2.0 REFERENCES

2.1 49 CFR 172, 173, 178, 179, DOT Hazardous Material Transport Regulations

2.2 Low-Level LEHR Waste Certification Plan for LEHR - UCD, Revision 2, April 1993

2.3 SOP 34.4 - "Clean Waste Handling"

2.4 SOP 35.1 - "Waste Certification"

2.5 WHC-EP0063-4, "Hanford Site Solid Waste Acceptance Criteria"

2.6 Envirocare of Utah, Radioactive Material License No. UT 2300249

3.0 DEFINITIONS

3.1 CFR

Code of Federal Regulations

3.2 Container

Container which complies with the requirements of the applicable disposal site waste acceptance criteria and DOT 49 CFR 172-178. Typically: Steel B-25 box or steel 55-gallon drum

3.3 D&D

Decontamination and Decommissioning

3.4 DAW

Dry Active Waste, radioactively contaminated solid waste which contains no liquids or hazardous waste

3.5 DOE

U.S. Department of Energy

3.6 DOT

U.S. Department of Transportation

3.7 EPA

U.S. Environmental Protection Agency

3.8 HEPA

High Efficiency Particulate Air

3.9 HW

Waste containing materials designated as hazardous by Environmental Protection Agency regulations in 40 CFR Part 261 or TSCA

3.10 HWP

Hazardous Work Permit

3.11 LEHR-ER

Laboratory for Energy-Related Health Research - Environmental Restoration

3.12 Liquid Waste

Liquids and sludge, either aqueous or organic, contaminated with radioactive and/or hazardous material

3.13 LLW

Low-Level Radioactive Waste which excludes hazardous material

3.14 LLWSDR

Low-Level Waste Storage/Disposal Record

3.15 RMW

Radioactive Mixed Waste, radioactive waste that also contains hazardous material as designated by EPA in 40 CFR Part 261

3.16 RMWAS

Radioactive Mixed Waste Attachment Sheet

3.17 Shipping Lid

Permanent container closure device

3.18 TSCA

Toxic Substances Control Act

3.19 WPA

Waste Packaging Area

3.20 RAM

Radioactive Material

3.21 WAC

Waste Acceptance Criteria

3.22 WPA

Waste Processing Area

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~~3.21~~3.23 WSF

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Waste Staging Facility

~~3.22~~3.24 WSRd

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Waste Specification Record

4.0 RESPONSIBILITIES

4.1 Field Coordinator (FC)

The FC is responsible for the implementation of this procedure, providing adequate staff to perform the work, ensuring that staff have required training, and providing the necessary equipment to perform the work.

4.2 Site Health and Safety Officer (HSO)

The HSO is responsible for establishing HWP requirements, establishing radiological and industrial hygiene monitoring requirements, and ~~directing the performance of surveys required to support packaging and shipment of waste,~~ directing the performance of industrial hygiene monitoring to ensure appropriate controls and personal protective equipment are being used. ~~, and providing the radiological information required for shipping and disposal documents.~~

4.3 Radiation Safety Officer (RSO)

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The RSO is responsible for providing the HSO with radiological HWP requirements, directing the performance of surveys required to support packaging and shipment of waste, and providing the radiological information required for shipping and disposal documents.

~~4.3~~4.4 Project Quality Assurance Specialist (PQAS)

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The PQAS is responsible for the performance of receipt inspections of disposal containers and other quality affecting waste packaging materials. The PQAS is also responsible for conducting surveillances of waste packaging activities and records.

~~4.4~~4.5 Waste Coordinator (WCo)

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The WCo is responsible for management of the wastes resulting from D&D activities. This includes waste identification, segregation, packaging, identification of required waste containers, review of packaging logs, preparation of disposal documents, authorization of container closure and transfer to the WSF, and supervision of Waste Packaging Observers.

~~4.5~~4.6 Waste Packaging Observer (WPO)

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The WPO is responsible for inspection of containers prior to use, ensuring installation of any required inner liners and absorbents, monitoring waste packaging activities to ensure exclusion of unauthorized materials, initiating and maintaining container logs in accordance with requirements of Section 7.3, and maintenance of packaging controls including installation and removal of tamper seals and package closure.

~~4.6~~4.7 Radiological Control Technicians (RCT)

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The RCT are responsible for the performance of radiological surveys, implementation of HWPs, air monitoring, and other H&S duties as assigned.

~~4.7~~4.8 Workers

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Workers are responsible for performing waste processing and waste packaging in accordance with the requirements of this procedure and complying with the directions of the WCo and WPO.

5.0 PRECAUTIONS

5.1.1 Package void spaces shall be minimized and shall not be more than ten percent (10%) of container volume, as required, to ensure compliance with disposal site criteria.

5.1.2 Understand and comply with HWP(s) and protective clothing requirements for working with materials to be packaged.

5.1.3 Protect outer surfaces of containers from possible contamination while loading them by draping with polyfilm when contamination levels warrant.

5.1.4 Get assistance for lifting and handling excessively heavy or cumbersome items.

5.1.5 Look for possible pinch points when placing materials in containers.

5.1.6 Exercise care when handling bagged items to maintain containment integrity.

5.1.7 Do not handle or attempt to package unknown materials.

5.1.8 Contact the HSO for direction when unknown materials are encountered.

5.1.9 Report suspected asbestos-containing or other potentially hazardous materials to the HSO. Proceed only with specific instructions from the HSO.

5.1.10 Do NOT mix liquids or hazardous materials with LLW.

5.1.11 Ensure that all identified hazardous material, actual and suspect, is segregated from other wastes and labeled for further evaluation.

5.1.12 Heavy materials placed in waste containers will be braced or blocked as necessary to prevent internal shifting during handling and shipping.

5.1.13 Tamper seals shall be applied as directed in this procedure.

5.1.14 Ensure that pressurized containers (e.g., aerosol paint cans) have been vented before container is packaged.

5.1.15 Objects that have sharp edges or protrusions which could penetrate plastic wrappings used for containment must be adequately padded to assure contamination control during packaging.

5.1.16 If unexpected safety concerns arise during work activities, place the work in a safe condition and contact the HSO for resolution of these concerns.

5.1.17 Loaded containers are not to be stacked in storage or in shipment unless the operational stresses are addressed in the engineering design of the containers.

6.0 PREREQUISITES

- Prior to initiation of waste processing and packaging, personnel will be trained in the application of this procedure.
- Procurement of all waste containers will be in accordance with Section 7 of the LEHR Quality Assurance Project Plan. Performance requirements and design specifications for testing, storage, packaging, transportation, and disposal of both full and empty containers shall be included in both the Request for Proposals and the award contract. Specifically, all DOT specifications shall be included in Request for Proposals and in purchase orders.
- As applicable, "as built" drawings for containers being tested shall be provided for approval before the delivery of the containers to the site.
- An ~~"Waste Profile" or "Waste Certification Summary"~~ HWP will be issued and its ~~their~~ requirements understood by the workers before work is initiated.
- Workers shall become aware of radiological conditions and other hazards in the WPA and with materials to be packaged.
- Disposal containers shall be inspected and accepted for use by QA at the time of receipt. The receipt inspection shall verify that all requirements specified in the contract and "~~as~~ as-built" drawings are completely met, specifically DOT specifications and applicable testing requirements for the specific intended use/wasteform to be associated with the containers. As applicable, it is paramount that containers are physically matched to "Lot" numbers~~"~~ or serial

numbers specified in "certificates of compliance" for required testing and design as part of the receipt inspection.

- The WPO and RCT shall be notified of the intent to package material well before work is initiated.
- The HEPA-filtered ventilation systems for the WPA will be in operation, if required by HWP, before work is started.

6.1 Equipment Required

6.1.1 Leather gloves or appropriate equipment, when handling materials having sharp edges, burrs, etc.

6.1.2 Lifting and rigging devices appropriate for handling items to be packaged.

6.1.3 Forklift or pallet jack for movement of empty and/or loaded containers.

6.1.4 Appropriate containers, e.g., B-25 metal boxes, metal 55-gallon drums, and/or other approved containers that may be designated in advance by the ~~Wco~~ WCo per the applicable disposal site .

6.1.5 Pallets to secure and transport 55-gallon drums.

6.1.6 Steel banding straps, clips, tensioning, and crimping tools used for banding operations.

6.1.7 Void space filler to ensure that waste container void fractions meet requirements specified in the specific disposal site criteria or Reference 2.3, as appropriate.

6.1.8 Approved absorbent material if small amounts of waste liquids are to be disposed as specified by the applicable disposal site waste acceptance criteria.

7.0 PROCEDURE

For packages of waste which are to be shipped to a facility for further processing prior to disposal, some of the requirements specified in Reference 2.3 will need to be performed at the processing facility. In these cases, the wastes being packaged may be exempted from the following requirements specified in Reference 2.3:

- Marking, labeling, packaging and manifesting requirements pertaining to immediate disposal; and,
- LLWSDR and all associated requirements.

In all cases, wastes being packaged for further processing must be capable of meeting all the requirements contained in Reference 2.3 after completion of processing activities.

7.1 Waste Processing

Waste processing will include the following activities:

- Waste segregation; and,
- Volume reduction of waste.

All processing work will be performed in an appropriate area with a HEPA-filtered ventilation system in operation or other controls as specified by the HWP.

7.1.1 Waste Segregation: Wastes will be segregated, at a minimum, according to their compactability, whether they can be volume- reduced, compatibility, and if they are potentially hazardous material. Waste items which may require contamination control measures prior to, or during their containerization will be pre-packaged and sealed in polyfilm as part of the segregation process. If needed, further segregation of the waste will be dictated by and described in workplans and/or technical guidance documents.

7.1.2 Volume Reduction of Waste: Compactable waste, such as anti-contamination clothing, PPE, wipe cloths (dry), and plastic wrappings should be volume reduced by penetrating the sealed containment bag with the nozzle of a HEPA-filtered vacuum cleaner, removing the majority of the air and resealing the bag.

7.1.3 Solid waste which can be volume-reduced, such as sheet-metal ducting, filter housings, and laboratory equipment should be manually segmented or disassembled to facilitate its packing efficiency. The degree of volume reduction will be dictated by the makeup of the subject waste, its related hazards, shipping container dimensions and existing contents, and by the projected manpower required to perform the work.

7.1.4 Volume-reduced waste should then be transferred to the WPA in preparation for final packaging.

7.2 Waste Packaging

7.2.1 Preparation: Stage the waste container(s) designated by the WCo in the WPA. The WCo will select containers based on the specification identified in the applicable waste profile or waste certification summary and the following general guidance.

- Strong, tight, metal boxes (as defined in Section 3.2 ~~B-25 or equivalent~~) for packaging of LLW only (wood, paper, plastic, wall board, stucco, piping, etc.)
- Open top, steel, 55-gallon drums (as defined in Section 3.2 ~~17H or equivalent~~) for packaging of LLW, RMW, and HW (contaminated soils, solidified or absorbed liquids, lab packed liquids, and solids, etc.)
- Other containers as dictated by work plans or field technical guidance document requirements (Roll-off bins).

7.2.2 Verify that each waste container staged for use has been assigned a Waste Tracking number and is accompanied by a Container Log

7.2.3 The WPO will iInspect each container including the shipping lid for visible cracks, holes, bulges, dents, corrosion or other damage which could compromise the integrity of the container. Chips and scratches in the paint and minor surface corrosion should be repaired by removing any corrosion using a wire brush or sand paper and painting the affected area with a compatible paint which matches the original color. Notify the WCo of any containers which are rejected. Rejected containers will be removed from the WPA.

7.2.4 Place absorbent or an absorbent pad in the container when required by the applicable waste profile or as directed by the WCo. See Reference 2.3, Appendix G, for a list of approved absorbents.

7.2.5 Install a liner into the container, if required. Liners for disposal containers will be specified in the applicable waste profile or waste certification summary. The WCo will specify the liner type for other containers.

7.2.6 Protect the exterior of the container against contamination by using a polyfilm covering when required by the applicable HWP or as directed by the RCT.

7.2.7 The container shall have a means to prevent tampering or unauthorized loading by use of a locking mechanism or a tamper seal.

7.2.8 **NOTE:** The shipping lid may serve as the designated work cover if tamper controls can be maintained.

7.2.9 Packaging: Verify that the WPO is present and has authorized packaging to begin.

7.2.10 Remove the designated work cover from the container. If a container is partially filled, the WPO shall remove the tamper seal or lock and record the removal on the Container Log. If there is evidence of tampering, packaging shall not proceed until the WPO has verified the container contents and corrected any discrepancies.

7.2.11 Segregate wastes by physical form (liquid or solid) and waste category (LLW, RMW, HW). Care should be exercised to preclude introduction of hazardous materials to existing wastes or cross contamination between waste streams. If needed, further segregation of the waste will be specified by workplans and/or field technical guidance documents. The WPO will be advised to these specifications prior to observing waste segregation and packaging.

7.2.12 Wastes to be packaged which have loose contamination above the limits for unconditional release shall be wrapped and sealed in at least one layer of plastic or other suitable contamination barrier. The waste container may be lined with a suitable material in lieu of wrapping individual items of waste. Waste which does not have loose surface contamination above the stated limits is exempted from this requirement. All wrapped materials must be inventoried prior to loading into a waste container and the contents listed on the Container Log. If needed, more specific waste packaging will be specified in work plans and /or field technical guidance documents.

7.2.13 Wastes which contain asbestos shall be adequately moistened and/or wetted, wrapped and sealed with at least two layers of 4 mil plastic. Asbestos waste packages shall have an asbestos warning sticker affixed to the exterior of each package prior to loading into a waste container. Package contents shall be listed on the Container Log.

7.2.14 Wastes which require wrapping shall have corners and other protrusions which could puncture the wrapping padded to preclude punctures.

7.2.15 Load wastes into containers, taking care to not damage waste packages or the container. Large, heavy or bulky items shall be braced or otherwise secured to prevent shifting during container handling or shipment. All wastes shall be listed on the Container Log.

7.2.16 A partially filled container shall not be left unattended unless the designated work lid is in place and locked or tamper sealed. The WPO shall record on the Container Log the time and date the seal or lock is affixed.

7.2.17 Radiation and contamination surveys will be performed on materials and/or waste containers during the loading process. This will ensure shipping limits are not exceeded and will provide information for making activity determinations.

7.2.18 Container Closure and Transfer: Verify that the WPO has authorized closure of the container.

Boxes

7.2.19 Seal the container liner, if used, with duct tape or as specified in the waste certification summary or waste profile.

7.2.20 Place the shipping lid onto the container.

7.2.21 Clean the gasket surfaces and install a new gasket on the box.

7.2.22 Place the box lid onto the box, taking care to not damage the gasket.

7.2.23 Install the lid closure clips, ensuring that they are fully engaged and locked in place. Boxes may also be secured using 3/4-inch painted steel banding. A minimum of three bands should be used per box.

Drums

7.2.24 Clean and inspect the drum and lid gasket and sealing surface for damage. If damage is noted, remove the damaged gasket, clean the surface, and install a new gasket. If damage to a sealing surface is noted, the drum lid shall be replaced with an undamaged lid. Damage to a drum will require that the drum is repacked into a new drum.

7.2.25 Install the drum lid onto the drum and install the drum closure ring. If the drum lid has bungs, verify that the bung plugs are installed and tight.

7.2.26 Secure the drum closure ring by tightening the bolt to a torque value of 40 ft. lbs. or as specified in the applicable waste profile or waste certification summary. The closure bolt shall be locked by tightening the locking nut against the threaded lug on the drum closure ring.

7.2.27 Install a tamper seal on the container, if required by the disposal site criteria.

7.2.28 The RCT shall perform a radiation and contamination survey on the container prior to transfer to the WSF or other designated storage location.

7.2.29 At the direction of the WCo, transfer the container to the WSF or other storage designated location.

7.2.30 **NOTE:** The following steps ~~may be done at any time~~should be completed immediately after container closure ~~and prior to shipment~~.

7.2.31 Weigh each container and record the weight on the Container Log. Ensure that container weights do not exceed manufacturer specifications or disposal site criteria, as appropriate.

7.2.32 Mark and label each container for storage, transport, and disposal (if required) in accordance with Section 7.3.

7.2.33 Drums should be palletized four per pallet using 3/4 inch painted steel banding. Drums shall be secured to the pallet to preclude movement during transport. Drums shall be oriented on the pallet to provide an unimpeded view of markings and labels .

7.3 Documentation

Documentation for each container prepared for storage, loading, transport, and disposal shall be prepared and maintained in project records.

7.3.1 Containers shall be inspected by QA at the time of delivery for compliance with the requirements of the purchase order, applicable waste certification summary or waste profile, and Reference 2.3. Inspections shall be performed and documented in accordance with the requirements of the Quality Assurance Project Plan.

7.3.2 A Container Log and Waste Tracking record shall be initiated for each container prior to beginning waste packaging in the container. The following information, at a minimum, shall be recorded on the Container Log and Waste Tracking record:

- Package Type, i.e., B-25 Box, 55-gallon Drum, etc.
- Package Number (may be sequential starting with 1, shall not be duplicated).

- Physical inspection of package for damage or defects. This is independent of the inspection performed in step 7.3.1 and ensures that containers which may become damaged or deteriorated in storage are repaired prior to use.
- Date and time container is placed in service including a description of any absorbent and/or liner which may be installed in the container.
- Date and time that waste loading into the container is started.
- If loading is stopped before the container is filled, the installation of the designated work cover and the tamper device shall be recorded including the date and time.
- When opening a partially loaded container to resume loading, the removal of the tamper seal and the designated work cover shall be recorded including the date and time.
- Inventory of container contents including physical description and estimated volume of each item or package. Volume should be reported as a percentage of container volume. Inventory should include waste, contamination barriers, absorbents, and void fillers.
- Date and time that the container shipping lid is installed.
- Gross weight of loaded container.
- Markings and labels which are affixed to a container.
- Each WPO that makes entries on a Container Log shall sign and date the log at the end of their respective entries.

7.3.3 A copy of the Container Log and container radiological surveys shall be attached to or otherwise maintained with the container for containers which have been sealed for transport.

7.3.4 A copy of the waste tracking record shall be provided to Waste Tracking Coordinator when a new record is developed or updated.

7.3.5 **NOTE:** The following steps may be completed at any time prior to shipment of waste containers and non-sequentially.

7.3.6 For each container which contains LLW or RMW packaged for disposal or storage at Hanford, a Low-Level Waste Storage/Disposal Record (LLWSDR) shall be prepared in accordance with the instructions provided. Otherwise, container shall be prepared in accordance with Reference 2.1 and the disposal site's WAC.

7.3.7 For each container being stored on site, labeling shall be affixed indicating status/classification, i.e., “pending analysis”, “radioactive waste, "hazardous waste," etc., and accumulation start date.

Waste that is hazardous must be marked "Hazardous Waste" and must be removed from the site within 90 days.

Waste stored in containers must meet containment requirements and must be inspected weekly.

~~1.1.8~~7.3.8 Each container which contains waste for disposal or storage at Hanford shall be marked as specified by the applicable disposal site waste acceptance criteria using preprinted stickers or stencils. Markings shall comply with the requirements of References 2.1, 2,3 and 2.5 ~~2.3 and Reference 2.5~~ for size, material, durability and location. All markings that are applied to a container shall be documented on the applicable container log.

Formatted: Bullets and Numbering

7.3.9 Each container containing waste which will be offered for transport shall be labeled for each primary hazard and each secondary hazard in the container. Hazard classifications and label requirements are identified in References 2.1 and 2.5. All labels shall comply with requirements of References 2.1 and 2.5 for size, shape, color, durability, number per package, and placement. All labels that are applied to a container shall be documented on the applicable container log.

7.3.10 Each container containing waste asbestos offered for transport shall be marked with the generator's name, address and EPA identification number, the proper shipping name, and the following warnings. ~~These markings should be in the form of a preprinted sticker or a stencil in a contrasting color with letters at least 1/2 inch high. All markings that are applied to a container shall be documented on the applicable container log.~~

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

AVOID BREATHING AIRBORNE ASBESTOS

HAZARDOUS WASTE

STATE AND FEDERAL LAWS PROHIBIT IMPROPER DISPOSAL. IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY OR THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES AND CONTROL

These markings should be in the form of a preprinted sticker or a stencil in a contrasting color with letters at least 1/2 inch high. All markings that are applied to a container shall be documented on the applicable container log.

7.3.11 The original Container Log for each container shall be maintained in the project records along with the LLWSDR, waste tracking form, as applicable, and a copy of the container survey. These documents shall be maintained for generation of the applicable shipping and disposal manifests and to provide copies for inclusion with the shipping packages.

7.4 Quality Assurance

7.4.1 Lessons Learned

7.4.2 Should any deficiencies or inadequacies be noted related to the LEHR waste packaging or transportation program they will be documented and lessons learned will be captured in accordance with Section 16.5 of the LEHR Quality Assurance Project Plan. This process is to ensure that problems can be solved and formally addressed in the form of worker training and revision of applicable SOP's and workplans.

7.4.3 Quality Related Documentation

All documentation generated as a result of this procedure will be controlled, reviewed, and maintained as directed by the PQAS and the Quality Assurance Project Plan.

7.4.4 Quality Assurance Inspections

The PQAS is responsible for the adequacy of performance and documentation of all quality affecting inspections, i.e., receipt inspections.

CONTAINER LOG Page__of

Container Number: Container Type: Date:

Contents (Material description, form, wrapping, etc.)	Volume %

Total of all Contents including liner, absorbent and void filler	

Comments

LOW-LEVEL RADIOACTIVE WASTE STORAGE

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure provides guidance for the temporary storage of packaged waste pending shipment off site. This procedure applies to the transfer of loaded waste containers to a designated storage location and the control and maintenance of stored containers. For the storage of loaded low-level radioactive waste (LLW) containers, the designated waste staging facility (WSF) will be the Geriatrics I building. Should it be necessary to store loaded HW or RMW containers, a location will be designated by WA.

2.0 REFERENCES

2.1 LEHR Radiological Controls Manual

2.2 Project Health and Safety Plan

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

4.1 Field Coordinator

The Field Coordinator (FC) is responsible for the implementation of this procedure, for providing the required equipment, and providing trained personnel.

4.2 Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) is responsible for the safety aspects of waste transfer and storage activities, issuance of Hazardous Waste Permits (HWPs) as required, and ensuring that radiological monitoring and postings comply with the requirements of Reference 2.1.

4.3 Waste Coordinator

The Waste Coordinator (WCo) is responsible for authorizing transfer of loaded containers to storage; designating container location in a storage facility; and inspection of containers prior to transfer, upon arrival at the storage facility, and periodically while in storage. The WCo will direct any relocation of containers stored in the facility.

4.4 Radiological Control Technicians

The Radiological Control Technicians (RCTs) are responsible for conducting all required radiological monitoring associated with the transfer and storage of waste containers. The RCTs are responsible for ensuring that the exterior surfaces of waste containers do not have removable contamination in excess of the limits specified in Table 2.2 of Reference 2.1. An RCT will escort each loaded container when it is transferred from the WSF or other designated storage location.

4.5 Workers

Workers are responsible for performing the work outlined in this procedure and complying with the requirements of an associated HWP.

5.0 PRECAUTIONS

5.1.1 Ensure that an HWP controlling the transfer of waste to on-site storage, if required, is issued prior to initiating transfer activities. The SHSO is responsible for specifying the use of an HWP when work is to be performed within a contamination area, radiation area or when other radiological or health and safety considerations warrant.

5.1.2 Ensure that waste container closure devices are properly secured.

5.1.3 Ensure that required documentation (Container Log and survey) accompanies the container. Copies of the documentation will be attached to one side of the container and oriented such that the information is visible while the container is in storage.

5.1.4 The WSF will be locked any time no one is in attendance. The facility key will be controlled by the FC and returned to the FC after use.

5.1.5 Move containers horizontally at an elevation sufficient to clear the floor. Pay strict attention to head-room requirements when elevating loads.

6.0 PREREQUISITES

Verify available storage space prior to transferring container.

6.1.1 Inspect the containers(s) for transport damage. If damage is evident, but containment is secure, return container to the waste packing area for repackaging. If containment is questionable, see Section 6.4, below.

6.1.2 The WSF is to be posted in accordance with LEHR Radiological Controls Manual (Reference 2.1).

6.1.3 If package containment is breached, establish appropriate contamination controls, have applicable surveys performed and, if deemed necessary by the RCT in attendance, invoke emergency measures in accordance with the Contingency Plan and General Emergency Response Procedures (CPGERP).

6.1.4 The FC shall inform the Project Manager in the event that these actions are taken.

6.1.5 Equipment/Material Required

- Forklift;
- Banding material and equipment; and,
- Pallet jack.

7.0 PROCEDURE

7.1 Receipt of Waste

Upon receipt of the waste containers, the WCo shall perform the following:

7.1.1 Inspect the waste container for:

- Secured and sealed covers;
- In-transit damage;
- Banding and in-place securing (drums);
- Condition of pallet (drums);
- Orientation of marking and labels (drums); and,
- Rust/unpainted surfaces.

Discrepancies shall be corrected prior to waste being accepted for storage. Problems that can be corrected without opening the package will be corrected at the WSF. All other discrepancies will require that the waste container(s) be returned to the packing area for correction.

7.1.2 Compare package number with the attached Container Log and container survey to ensure that they match. Ensure that the Container Log and survey are attached to the container in a location where they remain visible with the container in its storage location.

7.2 Storage Placement of Waste

7.2.1 To maximize available storage space, pallets and containers may be double stacked where there is sufficient clearance and as directed by the WCo.

Double-stacking must be done such that inspectors can perform weekly inspections to determine if containers have signs of deterioration and/or containment systems remain intact.

7.2.2 Place the container/pallet in the specified storage location, taking care to leave a minimum of 2-feet clearance between rows and adjacent to building walls.

Non-liquid waste will be stored to prevent contact with accumulated liquids (eg. on pallets) and in areas where run-on/run-off is controlled. Liquid wastes must be stored with a secondary containment system designed to contain precipitation from a 24-hour, 25-year storm plus 10% of the aggregate volume of all containers or the volume of the largest container (whichever is greater).

7.2.3 Perform and document a radiation survey of the area anytime conditions change (i.e., when waste is received, shipped out or relocated with in the facility). Repost the area and boundaries as necessary based on the radiological conditions.

7.2.4 Waste containing potentially hazardous waste must be labeled as such, even while analysis is pending. Potentially hazardous or radioactive mixed waste should be segregated from other waste.

7.3 Maintenance/Inspections

7.3.1 A radiation and contamination survey shall be performed at least weekly in the WSF and any time that conditions in the WSF change, such as adding or removing containers or relocating containers within the WSF.

7.3.2 The WCo or his designee shall inspect the WSF at least weekly. Containers shall be inspected as practical for physical condition, missing or damaged records, markings and labels. Any discrepancies shall be corrected as soon as practical and the FC informed.

Hazardous, potentially hazardous or radioactive mixed waste will be inspected and logged weekly. Container integrity and containment system effectiveness will be verified and logged.

8.0 RECORDS/DOCUMENTATION

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

Waste Management Weekly Inspection Checklist

Inspection Criteria	Authorized Storage Areas				
	Western Dog Pens	Eastern Dog Pens	Co-60 Field	Sample Lab	Geriatrics Building 1
Are stockpile covers properly secured and intact?	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:
Are storage areas secure? Doors and/or gates locked?	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:
Are packages closed and intact with no signs of damage or loss of integrity?	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:
Are storage areas properly posted?	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:
Are packages properly labeled?	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:
Are liquid wastes in a secondary containment system and spill kit?	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:
Are storage areas clean and free of debris/weeds?	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:
Is adequate aisle space available to properly inspect packages?	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:	☐Yes ☐No Explain:

Inspected by: ______________________________ ____________________
Signature Date

WASTE SHIPMENT

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure provides the guidance necessary to load and ship LEHR-generated wastes to disposal or processing facilities in accordance with state and federal regulations.

This procedure includes the shipment of low-level radioactive waste (LLW), hazardous waste (HW) and mixed low-level radioactive waste (MLLW) and is applicable to shipment scheduling, preparation of filled waste containers for shipment, receipt of the transport vehicle, preparation of the shipping/disposal documentation and loading the transport vehicle.

2.0 REFERENCES

2.1 *U.S. Department of Transportation (DOT) Hazardous Material Transport Regulations, 49 CFR 172, 173*

2.2 *Standard Operating Procedure (SOP) 34.1, Waste Packaging and Processing*

2.3 *SOP 35.1, Waste Certification for Off-Site Disposal*

3.0 DEFINITIONS

3.1 Carrier

A person engaged in the transportation of passengers or property by land or water as a common, contract, or private carrier or by civil aircraft.

3.2 Consignee

Facility operator receiving waste shipment.

3.3 Exclusive Use

Exclusive Use, also referred to as “sole use” or “full load”, is the sole use of a conveyance by a single consignor and for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. Specific instructions for the maintenance of exclusive use shipment controls must be issued in writing and included with the shipping paper information provided to the carrier by the consignor.

3.4 Hazardous Waste

Any material that is subject to the Hazardous Waste Manifest requirements of the U.S. Environmental Protection Agency specified in 40 Code of Federal Regulations (CFR).

3.5 Low-Level Radioactive Waste

Wastes containing source, special nuclear, or byproduct material which is acceptable for disposal at a low-level radioactive waste disposal facility.

3.6 Radioactive Material - Low-Specific Activity

Radioactive material as described in 49 CFR 173.

3.7 Radioactive Material

Any material having a specific activity greater than 0.002 microCuries per gram (µCi/g).

3.8 Mixed Low-Level Radioactive Waste MLLW

Radioactive waste that also contains hazardous waste as designated by the U.S. Environmental Protection Agency in 40 CFR 261.

3.9 Shipping Paper

Bill of lading, disposal manifest, Uniform Hazardous Waste Manifest or other shipping documents that, when used in the appropriate combination, meet all applicable requirements of 49 CFR 172.200.

4.0 RESPONSIBILITIES

4.1 Project Manager

The Project Manager (PM) is responsible for the implementation of this procedure, providing adequate staff to perform the work, ensuring that staff have required training, and providing the necessary equipment to perform the work.

4.2 Project Health and Safety Manager

The Project Health and Safety Manager is responsible for establishing hazardous work permit (HWP) requirements, establishing radiological monitoring requirements, directing the performance of surveys required to support loading and shipment of waste.

4.3 Project Quality Assurance Specialist

The Project Quality Assurance Specialist's (PQAS) primary responsibilities include reviewing Waste and Material Tracking System (WMTS) sheets for completeness and ensuring that this information is properly entered in the WMTS database by reconciling WMTS sheets with electronic database printouts.

The PQAS is also responsible for conducting surveillances of waste shipping activities and records.

4.4 Waste Broker

The Waste Broker (WB) is responsible for establishing shipping schedules; coordinating staging; loading and shipping activities; preparation of shipping papers, transport vehicle inspection and acceptance; marking and labeling of shipping packages; vehicle placarding; and establishing "Exclusive Use"" controls when required and authorizing departure of the shipment.

4.5 Waste Specialist

The Waste Specialist (WS) is responsible for defining the sampling frequency for project waste streams, evaluating analytical data, designating project waste streams, and completing waste profiles. The WS coordinates with selected waste disposal facilities in order to fulfill waste acceptance criteria specific to the waste disposal site. These activities include, but are not limited to the following: providing completed waste profiles or summaries and coordinating shipping logistics between the waste disposal facility and the WB.

4.6 Radiological Control Technician

The Radiological Control Technician (RCT) is responsible for the performance of radiological surveys, implementation of Hazardous Work Permits, air monitoring and other health and safety duties as assigned.

4.7 Waste Coordinator

The Waste Coordinator (WC) is responsible for supervision of waste management activities and implementation of all procedures related to waste management. The WC is responsible for ensuring that the WMTS is kept up to date throughout all stages of waste management, including transportation and final disposition.

4.8 Waste Packaging Observer

The RCT/Waste Packaging Observer (WPO) is responsible for the performance of radiological surveys, implementation of HWPs, air monitoring and other H&S duties as assigned. The WPO is responsible for providing oversight and first-line direction in packaging and handling of wastes. Under the supervision of the WC, the WPO verifies that waste streams meet all applicable certification requirements and provide information used in the WMTS.

4.9 All Personnel

All personnel are responsible for loading and securing waste packages on the transport vehicle in accordance with the requirements of this procedure and complying with the directions of the WC. All personnel at LEHR are responsible for identifying problems and reporting them to the appropriate staff. Additionally, all personnel have the authority to stop work if they encounter a situation which is unsafe and places them, their co-workers, the environment or the property in any danger.

5.0 PRECAUTIONS/PREREQUISITES

- The PM shall verify that DOE has notified the Southwestern Low-Level Radioactive Waste Commission when shipping waste for disposal outside of the Southwestern Low-level Radioactive Waste State Compact.

- The PM shall ensure that all measures have been taken and documented when commercial waste disposal facilities are to be utilized.

- The WC shall coordinate with the WS to ensure that all applicable requirements of Reference 2.3 are met when arranging for disposal of a waste stream.

- All employees shall understand and comply with the requirements specified during the tailgate safety meeting for loading and securing waste packages.
- The WC shall ensure all containers used in the transportation of hazardous materials meet applicable requirements specified in the LEHR Quality Assurance Project Plan and References 2.1, 2.2, and 2.3.
- The WB shall ensure that gross transport and axle weight limits are not exceeded.
- The WB shall perform a complete compliance inspection of each waste package to be shipped. This inspection is to document the complete compliance with applicable requirements of References 2.1, 2.2, and 2.3 or note non-compliance and ensure corrective actions are taken prior to shipment of packages.
- The WB shall distribute weight on the transport vehicle as prescribed by the vehicle operator.

- Packaged and sealed waste will be staged in on-site storage in advance of the scheduled shipping date.
- The WS and WB shall coordinate the shipping schedule at least two weeks in advance, when possible, with the consignee.
- The WB shall ensure that all waste packages are blocked and braced on the transport vehicle to prevent shifting of the load incident to normal transportation as required by Reference 2.1.
- Shipments of waste packaged in boxes shall be made on flatbed trucks. Boxes shall be secured on the truck with carrier provided and installed straps. A minimum of one strap per row of boxes shall be used, except that the first and last rows shall each have two straps. The load shall be covered with carrier-provided and installed tarps as directed by the WB.
- Shipments of waste packaged in drums should be made in van trucks.
- Waste shipments including both drums and boxes should be made in van trucks.
- The WB shall ensure that soft-sided containers are shipped in an appropriate conveyance.
- Lift-liners are completely inter-modal and are suitable for transport if blocked and secured to a flat-bed truck, in a dump bed with tarp, in a roll-off container, in an inter-modal container, or in a gondola rail car.
- Super Sacks shall be shipped in roll-off containers, inter-modal containers or sealed gondola cars and are not suitable for transport on a flatbed.
- The WB shall ensure that the bulk container (i.e. gondola, roll-off bin, etc.) is properly closed and sealed with tarps and/or hard top to prevent infiltration of water during transportation.
- Gondola cars, inter-modals or roll-offs shall be inspected for integrity, as they will become the external packages when completing bulk waste shipments.
- A safety inspection and a radiation and contamination survey of the transport vehicle will be completed prior to loading.
- The WC shall ensure that appropriate transport permits and site use permits are in place.
- The WB shall ensure that all wastes are properly classified, packaged, marked, labeled, and described in accordance with all appropriate disposal site criteria and Reference 2.1.

6.0 WASTE SHIPMENT PROCEDURES

Waste shipments should be tracked from scheduling to receipt at the consignee's facility using the Waste Shipment Checklist (Attachment 7.1). As each section is performed it should be documented on Attachment 7.1. Requirements on the checklist which do not apply to a specific shipment shall be marked "Not Applicable" (NA).

6.1 Scheduling

Waste shipments should be scheduled with the consignee at least two weeks in advance of the actual shipment date.

6.1.1.1 The WB will coordinate with the WS to complete all logistics that are specific to waste disposal sites(e.g., waste profile/summary approval, shipment scheduling, and any required notifications).

6.1.2 The WB shall confirm the scheduled shipment date with the disposal facility and transporter and assign a shipment number. Each shipment shall be numbered sequentially.

6.1.3 The WS shall verify notification of the consignee including the point of contact and the time and date.

6.1.4 The WB shall schedule the transport vehicle with the carrier and ensure that the carrier can comply with all applicable requirements.

6.2 Preparation of Waste Packages

Waste packages scheduled for shipment shall be verified as ready for shipment and staged for loading prior to the scheduled shipping date by the WC.

6.2.1 Physical Inspection: Each package which is part of a shipment shall be inspected for proper closure, application of tamper seals (if required), physical damage and package integrity in accordance with the requirements of Reference 2.1. Banding shall be tight and installed to preclude shifting which may allow it to become loose. Pallets shall be in good condition, free of broken or damaged slats and loose or missing nails. Discrepancies shall be corrected prior to release of the package for shipment.

6.2.2 Marking and Labeling: Package markings and labels shall be inspected for damage and correctness. Markings and labels shall be verified by comparison to the WMTS and in accordance with the requirements of Reference 2.1. Damaged or incorrect markings and labels shall be removed and replaced with the required markings and labels. Any special marking or labeling requirements prescribed by waste profiles/summaries shall be adhered to and verified by the WB.

6.2.3 Staging: After the packages (which comprise a shipment) are ready for shipment, they shall be staged in the waste storage facility or other designated storage area so they are easily accessible for loading onto the transport vehicle.

6.3 Shipping Papers

The documentation for each waste shipment will at a minimum consist of the following:

- Waste Shipment Checklist (Attachment 7.1), as applicable;
- Shipping Paper;
- Transport Vehicle Inspection Checklist (Attachment 7.2);
- Transport Vehicle Radiation and Contamination Survey;
- Waste Package Radiation and Contamination Surveys; and,
- Exclusive Use Instructions (Attachment 7.3), as applicable.

The contents and distribution of shipping document packages is detailed in Attachment 7.4. The following sections discuss the preparation of the required documentation for transport and, if applicable, disposal.

6.3.1 Shipping Paper: The shipping paper is the DOT-required document which at a minimum identifies by name and address the consignor, the carrier, the consignee, the number of packages associated with each description, a description of the materials being transported, the total weight of the materials with their packaging, the loading address, the delivery address, a billing address, the signatures of agents of the consignor and the carrier. Straight Bill of Lading forms are commercially available which provide for inclusion of the above information.

6.3.2 DOT-Exempt Shipments: Shipments which do not contain any and which have a specific activity of less than 0.002 µCi/g of radioactive material are exempted from the requirements of Reference 2.1 and are only required to have a Straight Bill of Lading with the information described in the Section 6.3.1.

6.3.3 Radioactive Material, Limited Quantity: Shipments which do not contain HW and which contain DOT-regulated radioactive material in quantities less than the limits of Reference 2.1 for limited quantities of radioactive materials require that the following limited quantity compliance statement (Reference 2.1) be included on the outside of the inner package, outside of the outer package, or otherwise included with any shipping documents. The name and address of either the consignor or consignee must also appear.

"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."

Note: See Reference 2.1 for requirements that apply to other excepted-package shipping descriptions.

6.3.4 Radioactive Material: Shipments which do not contain HW and which contain DOT-regulated radioactive material in quantities greater than described in Section 6.3.3 require specific information in addition to the requirements of Section 6.3.1. The description must include the proper shipping name (Reference 2.3). The description must also include the words "Radioactive Material" unless they are contained in the proper shipping name. Each radionuclide in the material must be listed by name. The physical and chemical form and the total activity contained in the shipment must be included. The hazard class (Reference 2.1) must follow the proper shipping name, followed by the DOT identification number (Reference 2.1) and the packaging group (Reference 2.1). An example is provided for low-specific activity (LSA) material:

"Radioactive Material, LSA, nos., 7, UN2912, Ra-226, Sr-90, Y-90, Cs-137 as solid oxides and salts on wood, paper, plastic and building debris, (5 Ci total activity) packaged in 96 ft^3 strong, tight, metal boxes."

6.3.5 Asbestos Waste: The Uniform Hazardous Waste manifest shall be completed in accordance with the instructions provided with the form. Specific information required includes the EPA identification number for the generator, the carrier(s) and the consignee as well as the proper shipping name (Reference 2.1), physical description, DOT identification number, packaging group and a description of the packaging. Wastes which contain asbestos and DOT-regulated radioactive material shall have a shipping paper which complies with the requirements of Section 6.3.4 or Section 6.3.5, as applicable, as well as the requirements of this section. The radioactive material shall be listed first on the shipping paper. The Uniform Hazardous Waste Manifest may be used in conjunction with a Bill of Lading as described in Sections 6.3.4 and 6.3.5 or alone provided that all required information is listed. An example description is provided for a shipment which contains a limited quantity of radioactive material and asbestos:

"Radioactive Material, excepted package-limited quantity of material, 7, UN2910, RQ, Waste Asbestos, 9, NA 2212, PG III, building debris contaminated with asbestos packaged in 96 ft^3 metal, strong, tight boxes."

6.3.6 Mixed low-level radioactive waste (MLLW): These shipments shall have a Uniform Hazardous Waste Manifest. MLLW which contains DOT-regulated radioactive material shall also comply with the requirements of Section 6.3.4 or Section 6.3.5, as applicable. The Uniform Hazardous Waste manifest shall be completed in accordance with the instructions provided with the form. Specific information required includes the EPA identification number for the generator, the carrier(s) and the consignee as well as the proper shipping name (Reference 2.1), physical description, DOT identification number, packaging group, EPA waste identification number, and a description of the packaging. The radioactive material shall be listed first on the shipping paper. The Uniform Hazardous Waste Manifest may be used in conjunction with a Bill of Lading or alone provided that all required information as described in Section 6.3.1 and Sections 6.3.4 or 6.3.5 is provided.

6.3.7 Hazardous Waste (Resource Conservation and Recovery Act and/or California): Should this type of shipment be necessary, a Uniform Hazardous Waste Manifest and any disposal facility-specific documents will be required. The Uniform Hazardous Waste manifest shall be completed in accordance with the instructions provided with the form. Specific information required includes the EPA identification number for the generator, the carrier(s) and the consignee as well as the proper shipping name (Reference 2.1), physical description, DOT identification number, packaging group, EPA waste identification number, and a description of the packaging. The information required by Section 6.3.1 must also be included. Instructions for the completion of disposal facility-specific documents should be obtained from the disposal facility.

6.3.8 All Regulated Shipments: Shipping papers prepared in accordance with Sections 6.3.4 through 6.3.7 all require that the following information be provided:

- Emergency Contact - The name and telephone number of a person with direct knowledge of the materials in the shipment who can be reached directly by telephone 24 hours per day in the event of an emergency.
- Markings, Labels and Placards - All DOT-required markings, labels and placards, as applicable, shall be described on the shipping paper. An example for Radioactive Material, LSA, not otherwise specified, follows:
  1. Marking(s): Radioactive Material, LSA
  2. Label(s): None
  3. Placards: "Radioactive", Class 7.

4. Shipper's Certification - Certification by the shipper that the shipment is offered for transport in compliance with the applicable DOT regulations. The following statement shall be on the shipping paper:

   "This is to certify that the above named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation."

6.3.9 Signatures: The shipping paper, including the above certification, shall be signed by an authorized agent of the consignor. The signature should be accompanied by the agent's organization, printed name, title or authorization. The vehicle operator shall sign the shipping paper, accepting the shipment for transport, as the authorized agent of the carrier and should be accompanied by the operator's printed name and organization.

6.3.10 Consignee Concurrence: Concurrence to accept the shipment should be received from the consignee prior to releasing the shipment from the site. This may be accomplished by transmitting a copy of the shipping paper to the consignee and receiving verbal confirmation from an authorized agent of the consignee.

6.4 Transport Vehicle Receipt

6.4.1 Vehicle Inspection: The WB will perform an inspection of the transport vehicle prior to loading. The inspection will be documented on the Transport Vehicle Inspection Checklist (Attachment 7.2). Discrepancies will be evaluated on a case-by-case basis and the WB will make a determination to accept the vehicle as is or reject it. The carrier shall be notified when any vehicle is rejected. The WB shall coordinate with the carrier to schedule a replacement vehicle.

6.4.2 Radiological Survey: The WB or designee will perform a radiation and contamination survey on the incoming vehicle to ensure compliance with the requirements of the LEHR Radiological Protection Program and Reference 2.1. Vehicles having contamination (fixed or removable) above the limits of the LEHR Radiological Protection Program, but less than the limits of Reference 2.1, shall be evaluated on a case-by-case basis and may be used with the PM's and PHSM's or (designee's) concurrence. Vehicles with contamination in excess of the limits of Reference 2.1 shall be rejected and the carrier notified by the WB.

6.5 Shipment Loading

6.5.1 Load the staged waste packages onto the transport vehicle. The WB, in coordination with the vehicle operator, will direct the placement and location of packages. Packages shall be placed to ensure that radiation dose rates are in compliance with the requirements of Reference 2.1 and the vehicle axle and gross weight limits are not exceeded. Specific weight limits can be obtained from the carrier and the vehicle operator.

6.5.2 Install blocking to prevent movement of the load during transit. At a minimum, the load shall be braced in the front and in the rear to prevent shifting during acceleration and braking. Packages loaded into a van shall be blocked on the sides to prevent lateral movement. The WB will direct the placement of blocking and bracing.

6.5.3 The RCT shall perform a radiation and contamination survey of the loaded transport vehicle. Radiation dose rates shall be less than 200 millirems/hour on contact with the packages, less 10 mr/hour at two meters from the vertical plane of the edge of the transport vehicle, and less than 2mr/hour in any portion of the transport vehicle which is normally occupied by the operators (sleeper and cab). (There are specific exceptions to the dose rates specified above for shipments consigned as exclusive use in a closed transport vehicle.)

6.5.4 Waste shipments which consist of boxes loaded on a flatbed shall be secured with straps. The carrier is responsible for providing and installing the straps. Straps may be installed at any time after vehicle loading begins. At a minimum, each row of boxes shall be secured with one strap, except that the first and last rows of boxes shall have two straps installed. The WB will direct the operator to install all straps when bracing has been installed and required radiological surveys have been completed. If directed by the WB, tarps should completely cover the load such that no portion of the waste packages are exposed to the elements.

6.5.5 Placards, if required by Reference 2.1, shall be installed on the transport vehicle. The required placard(s) shall be installed on the front, rear and both sides of the trailer. If the placard(s) on the front of the trailer are obstructed from view by the tractor, then the required placards shall also be installed on the front of the tractor.

6.6 Shipment Release

6.6.1.1 The WB shall brief the transport vehicle operators on Exclusive Use Controls, Emergency Notification Instructions and Emergency Response Instructions. These instructions are provided in Attachment 7.3 and copies shall be provided to the operators.

6.6.1.2 The WB shall finalize the document packages by ensuring that all required documents have been included in the package and necessary signatures have been obtained. Document package contents and distribution are detailed in Attachment 7.4. The WB will brief the transport vehicle operators on the document packages, which accompany the shipment.

6.6.1.3 The WB shall verify that all requirements have been completed and request DOE agent signature authorization for release of the shipment off site. This authorization may be obtained from Weiss Associates as an authorized agent of the DOE (Generator/Shipper). The WB shall authorize the transport vehicle to depart the site.

6.7 Shipment Delivery

Verification of the delivery of the shipment shall be obtained and documented in the WMTS. Verification may be received from either the carrier or the consignee. Delivery occurs when the consignee signs the shipping paper accepting custody of the material.

6.8 Lessons Learned

In the event of any noted deficiencies or inadequacies related to the shipment of waste materials associated with the LEHR project, they will be documented and lessons learned will be captured in accordance with Section 16.5 of the LEHR Quality Assurance Project Plan. This process is to ensure that problems can be solved and formally addressed in the form of worker training and revision of applicable SOPs and work plans.

7.0 ATTACHMENTS

7.1 Waste Shipment Checklist

7.2 Transport Vehicle Inspection Checklist

7.3 Instructions for Exclusive Use Drivers

7.4 Document Package Distribution

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 7.1

WASTE SHIPMENT CHECKLIST

Waste Shipment Checklist

Completed By:

Scheduling ________________

Shipment Date ________________
Shipment No. ________________
Consignee Notified
Contact ______________________
Time and Date ________________
Schedule Transport Vehicle
Contact ______________________
Time and Date ________________
Vehicle Type __ Flatbed __ Van
CA Hazardous Material Transport Certification No. ________________
Expiration Date ________________

Preparation of Waste Packages ________________

Physical Inspection of Packages

Packages Staged for Shipment ________________

Shipping Documents ________________

Shipping Paper	________________
DOT Exempt	________________
Radioactive Material, Limited Quantity	________________
Radioactive Material	________________
Asbestos Waste	________________
Radioactive Mixed Waste (LLWSDR)	________________
Radioactive Mixed Waste (RMWAS)	________________
Hazardous Waste	________________
Concurrence Received from Consignee	________________
Contact	________________
Time/Date	________________

Waste Shipment Checklist (cont.)

Completed By: ________________

Scheduling
Transport Vehicle Receipt

Vehicle Inspection ________________
Radiological Survey ________________
Survey No. ____________

Shipment Release

Driver Briefings ________________
Exclusive Use Controls
Emergency Notification Instructions
Emergency Response Instructions

I have been briefed on the requirements for Exclusive Use Controls, Emergency Notification and Emergency Response and received copies of the instruction.

Driver ________________

Vehicle Release
Shipment is authorized to depart the site

DOE Authorization ________________________________
Time/Date ________________________________
WCo Authorization ________________________________
Time/Date ________________________________

Shipment Delivery

Verbal notification of shipment receipt by consignee received
Contact ________________________________
Time/Date delivered ________________________________
Notification received by ________________________________
Time/Date ________________________________

ATTACHMENT 7.2

TRANSPORT VEHICLE INSPECTION CHECKLIST

Transport Vehicle Inspection Checklist

Tractor No. ______________________________
Trailer No. ______________________________

	SATISFACTORY	UNSATISFACTORY
General Condition		
Windshield		
Windows		
Mirrors		
Horn		
Trailer Deck/Floor		
Headlights		
Tail lights		
Turn Signals		
Clearance Lights		
Tractor Front Tires		
Tractor Rear Drive Tires		
Trailer Front Axle Tires		
Tractor Rear Axle Tires		
Tractor Front Hubs		
Tractor Front Drive Hubs		
Tractor Rear Driver Hubs		
Trailer Front Axle Hubs		
Trailer Rear Axle Hubs		
Tractor Front Drive Wheels		
Tractor Rear Drive Wheels		
Trailer Front Axle Wheels		
Trailer Rear Axle Wheels		

Transport Vehicle approved for use ☐
Transport Vehicle rejected for use ☐ *Note: If rejected notify the WCo and the FC*

Inspector (please print) ______________________________

Inspector Signature and Date : ______________________________

Driver Signature and Date: ______________________________

ATTACHMENT 7.3

EXCLUSIVE USE INSTRUCTIONS

INSTRUCTIONS FOR EXCLUSIVE USE DRIVERS

The following are instructions for maintenance of exclusive use shipments and shall be complied with when transporting materials under exclusive use control.

In the event of an accident, vehicle malfunction, or deviation from these instructions immediately notify the following:

Dave Ochs: IT Corporation: (916) 752-2916 or (916) 693-0854 (24 hr.)

- Do not change out tractor before arrival at destination without first notifying the shipper.
- Do not change the fifth wheel adjustment on the tractor without first notifying the shipper.
- Do not move or transfer packages on the conveyance or between conveyances while en-route to destination without first notifying the shipper.
- The shipment must be loaded by the consignor and unloaded by the consignee from the transport vehicle in/on which it was originally loaded.
- Shipments must be loaded so as to prevent shifting of the load under the conditions normally incident to transport.
- If the vehicle is involved in an accident, or is required to brake in an emergency causing the load to shift, notify the shipper immediately.
- If an accident or release of material occurs notify the shipper and local, state and federal authorities as appropriate and comply with the requirements of shipper supplied Emergency Response Guideline.

ATTACHMENT 7.4

DOCUMENT PACKAGE DISTRIBUTION

Document Packages

	CARRIER	CONSIGNOR	CONSIGNEE (SHIPMENT)	CONSIGNEE (MAIL)	PROJECT FILE
Waste Shipment Checklist [1]		X			Original
Transport Vehicle Inspection Checklist [2]	X	X			Original
Exclusive Use Instructions [3]	X	X			X
Shipping Paper	Original	X	X	X	X
Disposal Manifest [4]	X	X	Original	X	X
Radiological Surveys	X	X	X	X	Original
Container Logs		X	X	X	Original
Package Surveys		X	X	X	Original
Photocopy of Drivers License		X			X
Emergency Response Guide	X	X			X

1.) *See Attachment 1*
2.) *See Attachment 2*
3.) *See Attachment 3*
4.) *Includes LLWSDR, RMWAS and/or Uniform Hazardous Waste Manifest as applicable.*

CLEAN WASTE HANDLING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

The purpose of this document is to provide the information and guidance necessary to designate, handle, and store clean waste generated by the environmental restoration (ER) effort.

This procedure includes the following:

- Surveying the waste to provide documented evidence that it is uncontaminated;
- Containerizing the waste as necessary to efficiently transfer it to a Clean Waste Laydown Area (CWLA);
- Transferring the waste to the CWLA; and,
- Documenting all pertinent information (waste description, radiological survey, approximate location in CWLA, its origination location, etc.) to facilitate its final release.

The accumulation and disposition of sanitary waste is excluded from this work scope since it is being handled by existing procedures and methods. Nonradiological hazardous/ asbestos containing materials are excluded from consideration since they will have been previously addressed by other operating procedures (Reference 2.1, and 2.2).

2.0 REFERENCES

2.1 SOP 34.1 - Low-Level Radioactive Waste Processing and Packaging

2.2 SOP 35.1 - Waste Certification

3.0 DEFINITIONS

3.1 Clean Waste

Waste that is non-hazardous and non-radioactive, either as an original condition or as the result of treatment to render it non-hazardous and/or to reduce its radioactivity levels below DOE LEHR-ER project unconditional release criteria.

3.2 CWLA

Clean Waste Laydown Area - A designated outside area where waste awaiting analytical/survey results will be stored

3.3 CWB

Clean Waste Bin

3.4 LLW

Low-Level Waste

3.5 UC Davis

University of California at Davis

3.6 Sanitary Waste

Waste continually generated by LEHR's normal work processes not part of the ER effort (e.g., paper towels, drinking cups, non-hazardous, non-radioactive laboratory waste, etc.)

4.0 RESPONSIBILITIES

4.1.1 The Site H&S Officer (SHSO) is responsible for the requests for, and receipt of radiological analyses and surveys necessary to designate clean waste.

4.1.2 The Waste Coordinator (WCo) is responsible for the following:

- Verification of waste designation as clean;
- Placement of clean waste in CWLA;
- Maintaining the CWLA Storage Log and file of related documentation; and,
- Scheduling and initiation of verification action to release the waste.

4.1.3 The Field Coordinator is responsible for ensuring properly trained workers involved in clean waste handling and for the availability of those workers.

4.1.4 The Radiological Control Technicians are responsible for conducting all radiation, contamination, and airborne surveys during the performance of this procedure.

4.1.5 Work personnel are responsible for performing the work outlined in this procedure in accordance with it's requirements and those of the applicable HWP.

5.0 PRECAUTIONS

Ensure that waste to be handled by this procedure has been spot-checked to justify its preliminary designation as clean waste.

Ensure that sanitary waste remains separate from the Project effort's clean waste.

6.0 PREREQUISITES

ER workers will be instructed to exclude the sanitary waste category from the ER waste accumulation.

Document the results of screening surveys by Radiological Control Technician which provide a basis for decontamination, or tentatively designate clean waste.

6.1 Equipment Required

6.1.1 Hand trucks

6.1.2 Accumulation bin, fork lift transportable (distinctively labeled as "ER Clean Waste Only")

6.1.3 Safety equipment (hard hat, leather gloves)

6.1.4 Pallets.

7.0 PROCEDURE AND ACCUMULATION

7.1 Accumulation and Analysis of Material

7.1.1 Soil/gravel: Soil and gravel will be accumulated in 55-gallon drums as it is removed from the work location. The WCo will notify the SHSO to have analytical samples taken, in accordance with applicable protocols. The loaded drums will be sealed, identified, and placed in the CWLA to await results of their sample analyses.

7.1.2 Other Debris: Materials dislodged/produced during ER work which have been tentatively designated as clean waste and segregated as such (Reference 2.1) will be subjected to a thorough radiological survey which will represent the waste's documentation record, identifying it as clean waste. The waste will then be transferred to the CWB using appropriate methods (hand truck, forklift, etc.). The CWB will be kept closed and locked, except for filling and emptying operations. When the CWB is full, it will be transported to the CWLA, its contents placed in storage there, and the emptied CWB returned to its waste receiving location. If the waste does not meet the "clean waste" criteria, it will be returned to the contaminated waste stream for processing and packaging in accordance with Reference 2.1.

7.2 Required Documentation

A Storage Log will be generated to receive the following information, as a minimum:

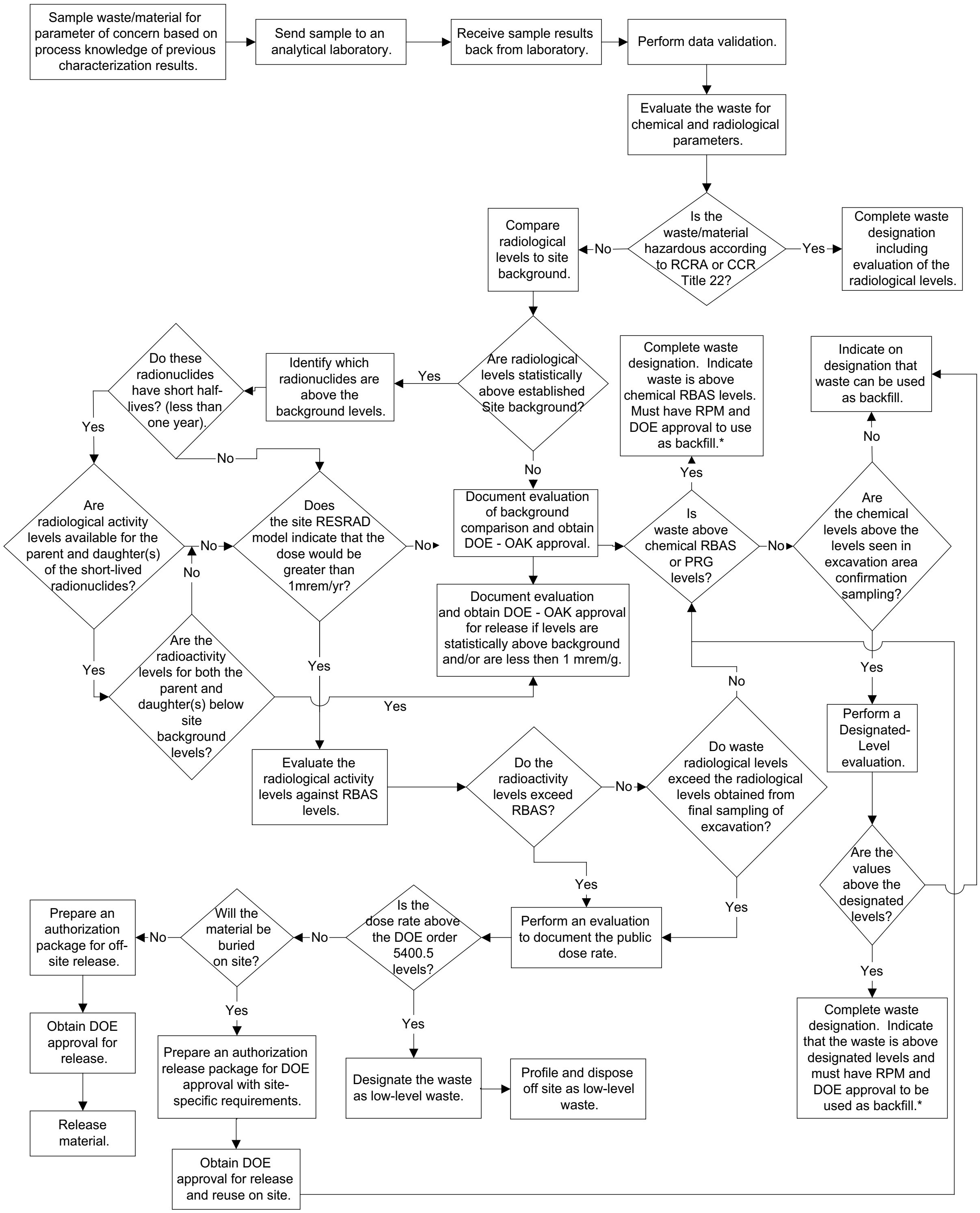
- Date of storage;
- Waste description;
- Clean survey I.D. number; and,
- Approximate location in CWLA.

The Log and copies of all radiological surveys will be maintained by the WCo.

8.0 ATTACHMENTS

None.

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.



* If RPM approval to use material as backfill is denied, then the material will be designated as waste and shipped off site for disposal.

LIST OF ABBREVIATIONS

RBAS	Risk Based Action Standards
RCRA	Resource Conservation and Recovery Act
CCR	California Code of Regulations
RESRAD	Residual Radioactivity Computer Code
RPM	Remedial Project Manager
PRG	Preliminary Remediation Goal
OAK	Oakland
DOE	Department Of Energy
mrem/g	millirem per gram

Attachment 11.1 Waste/Material Evaluation Process

Weiss Associates

WASTE TRACKING SYSTEM

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) provides protocol and requirements for the completion of Waste Tracking Sheets (WTS) and the maintenance of the Waste Tracking System database as part of the LEHR Waste Tracking System. Details within this SOP serve to augment field level verbal instruction and formalize the process so that it remains consistent and accurate.

2.0 REFERENCES

2.1 *49 CFR 172.200 "Shipping Documents"*

2.2 *49 CFR 173.403 "Transport Index"*

2.3 *Code of Federal Regulations, 40 CFR 261.20 Subpart C - Characteristics of Hazardous Waste*

2.4 *Code of Federal Regulations, 40 CFR 261.20 Subpart D - Lists of Hazardous Waste*

2.5 *LEHR Quality Assurance Project Plan*

2.6 *State of California - Hazardous Waste Codes for Hazardous Waste Management; Title 22*

2.7 *State of Utah - Hazardous Waste Codes for Hazardous Waste Management*

2.8 *State of Washington - Hazardous Waste Codes for Hazardous Waste Management*

2.9 *SOP-34.2 "Low-level Radioactive Waste Storage"*

3.0 DEFINITIONS

This section defines the terms presented on the WTS, Form Number SOP 34.5, and provides examples of information which might be included on the form. Attachment 6.1 is an example of a blank WTS, Form Number SOP 34.5. A completed sample WTS is presented in Attachment 6.2 and should be referenced when reviewing this section.

3.1 New / Update

The New or Update box is checked as applicable on the WTS. The New Box is checked when the form is being filled out for the first time with a unique package number assigned to the waste. The Update Box is checked when the form is being modified (for example, corrections are made or additional information is provided to an already existing WTS) and no new package number is being assigned.

3.2 Package Number

The package number is the unique Identification Number assigned to the waste package, e.g., LEHR 0500.

3.3 Package Type

The package type is the kind of package that contains the waste. The package type may be a drum, a box, a tank, a bin, a five gallon or one liter container, or even a stockpile. A description of package types is located in a footnote box on the lower left side of the WTS. The package type should be selected from the options presented in that box, e.g., 55 gallon drum in an 85 gallon drum overpack.

3.4 Department of Transportation Container Type

The Department of Transportation (DOT) container type refers to the container the waste is shipped in. Approved DOT shipping containers must be used when required. Such a container is one which complies with the requirements of the Storage/Disposal Record, Waste Specification Record, Waste Profile, and/or DOT 49 CFR 172-178, as applicable. Use the international DOT classification designation, e.g., steel B-25 “Strong Tight” container, Type A or Type B.

3.5 Waste Description

The waste is described in terms of its various constituents in descending order by volume. A brief but accurate description of the waste should be used whenever possible. Options from the footnote box located on the lower center portion of the WTS should be used. The specific type of debris should be defined on the WTS. Along with the waste description, the approximate percentage of each type of waste in the container should be included on the WTS, e.g., 60% soil, 30% gravel, 10% plastic.

3.6 Waste Designation

The waste designation describes the waste with respect to it being hazardous or containing radioactivity. The "hazardous" description is further delineated as to whether it is hazardous by state and/or federal government(s). Waste designations include low-level radioactive waste; Federally and California regulated mixed waste, hazardous waste, and combined waste; Radioactive Material Management Area waste; clean waste; potentially mixed waste pending analysis; transuranic waste; and unknown waste. Transuranic waste consist of any transuranic radionuclide with activity greater than 10 nanoCuries per gram (nCi/g). "To Be Determined" should be used when designation is not available. Typical examples of waste designations are included in a footnote box located near the lower right corner of the WTS.

3.7 Compatibility Review Results

A compatibility review is performed to ensure the waste is physically compatible with storage containers and the other waste stored in the same container. The compatibility review is based on process knowledge, historical storage configuration, and analytical data. The results of the review are summarized on the WTS.

3.8 Hazardous Waste Code

The hazardous waste codes are alpha-numerical designators or similar codes that are assigned to waste to distinguish how the waste is hazardous. The hazardous waste code is obtained from the waste designation report. The entry on the WTS should specify the federal RCRA Codes (References 2.3 and 2.4) or State Codes (References 2.6, 2.7, and 2.8) as applicable. A sample waste designation report showing the applicable hazardous waste code to be included on the WTS is presented in Attachment 6.3.

3.9 Maximum Dose Rate

The maximum dose rate measured at the surface (one centimeter) of the waste container using a dose rate meter is recorded here. The maximum dose rate is determined from the survey data and is measured in microRoengton per hour (µR/hr).

3.10 Hot Spot

A hot spot is a local area of radiation dose measured at surface (one centimeter) of the waste container using a survey instrument that is significantly higher relative to the adjacent areas. The hot spot dose is recorded in milliRoengton per hour (mR/hr).

3.11 Survey Number

A radiological survey is performed for loose and fixed surface contamination and dose rates on the waste package. The corresponding survey number(s) obtained from the survey form(s) should be included here.

3.12 Date Waste Was Generated

The date the waste was generated will correspond to the date the waste was packaged or put in a container regardless of whether it has been characterized.

3.13 Origin of Waste

The origin of waste is a description of where the waste came from and often includes coordinates and depths. Use the notes section of the WTS to provide more detailed information such as knowledge which may be helpful to supplement survey information.

3.14 Waste Origination

Waste origination refers to the remedial action or waste management activity or process responsible for generating the waste. Typical examples of this type of waste origination include Limited Field Investigation, Southwest Trenches Investigation, and Phase 1 Imhoff. The waste origination may also consist of the name of the waste, e.g., miscellaneous waste or Investigation Derived Waste.

3.15 Process Knowledge/History

Process knowledge/history refers to methodology of characterizing a waste stream by reviewing the origin of the waste and the process which may have exposed the waste to contamination.

3.16 Sample Numbers

Any samples collected for characterization of the package waste are assigned sample numbers (e.g., SSDTF999) which are recorded on the WTS. The sample number can be used as a cross-reference to additional sample information that may be contained on the Sample Log.

3.17 Laboratory

The name of the analytical laboratory where samples collected for characterization of the packaged waste have been sent.

3.18 Storage Location

The storage location refers to the area where the waste is stored while awaiting characterization and final disposition.

3.19 Date Sealed

The date sealed refers to the date when the package containing the waste is sealed.

3.20 Storage Start Date

The storage start date refers to the date when the waste has been placed into storage.

3.21 Accumulation Start Date

The accumulation start date refers to the date when waste material slated for disposal enters the container. It is applicable to all waste carrying a hazardous waste code and indicates when the time clock starts for hazardous waste accumulation for further disposition.

3.22 External Package Volume

The external package volume is based on the outer dimensions of the package. All package volumes should be verified in the field and recorded in cubic feet.

3.23 Volume of Waste

The volume of waste indicates how much waste there is by volume disregarding any container. The volume will be recorded in cubic feet. The percentage of the volume of waste to the internal package/container volume is optional.

3.24 Total (container and waste) Weight

The container weight refers to the total weight of the container and the waste; not just the weight of the empty container. The weight is recorded in pounds.

3.25 Internal Package Volume

The internal package volume refers to the internal volume of the package determined by the inner dimensions of the package and is recorded in cubic feet. The package volume establishes a volume limit on the waste.

3.26 Container Tare Weight

The container tare weight refers to the weight of the package prior to adding the waste and is recorded in pounds.

3.27 Pre-disposal Treatment Type

The pre-disposal treatment type refers to any treatment performed on the waste prior to shipment or to treatment that is required to be performed by the treatment, storage, and disposal facility prior to disposal. Typical treatment technologies consist of stabilization, neutralization, encapsulation for lead, pH adjustment of a liquid.

3.28 Treatment Date

The treatment date is the date when any treatment performed on the waste is completed.

3.29 Waste Storage/Disposal Record Number

The Waste Storage/Disposal Record number is the unique number, primarily a package identification number, which has been assigned to the waste on the Waste Storage/Disposal Record. The Waste Storage/Disposal Record number allows for a cross-reference between the WTS and the Waste Storage/Disposal Record in order to obtain pertinent information required by the Waste Acceptance Criteria for the DOE disposal facility in Hanford, Washington. A sample Waste Storage/Disposal Record with the applicable record number to be included on the WTS is presented in Attachment 6.4.

3.30 Portfolio Number

The portfolio number is a shipping number assigned by the DOE disposal facility in Hanford, Washington as part of their system of managing waste shipments. It is not applicable if waste is shipped to disposal sites other than Hanford.

3.31 Shipment Number

The shipment number is the unique number assigned by LEHR project personnel to a shipment for purposes of identification and tracking the waste shipment at the LEHR site.

3.32 Bill of Lading Number

The Bill of Lading number is assigned by a waste broker as a unique control number for the shipment of the waste and it is made part of the shipping package. A sample Bill of Lading showing the number which needs to be included on the WTS is presented in Attachment 6.5.

3.33 Hazardous Waste Manifest Number

The hazardous waste manifest number is assigned by a waste broker as a unique number associated with the manifest or shipping document that provides a description and record of the hazardous waste and is made part of the shipping package. A sample hazardous waste manifest showing the applicable number to be included on the WTS is presented in Attachment 6.6.

3.34 Radioactive Waste Manifest Number

The radioactive waste manifest number is assigned by a waste broker as the unique number associated with the manifest or shipping document that provides a description and record of the radioactive waste and made part of the shipping package. A sample radioactive waste manifest showing the applicable number to be included on the WTS is presented in Attachment 6.7.

3.35 Transportation Index

The Transportation Index is the dimensionless number (rounded to the first decimal place) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The Transportation Index is a number expressing the maximum radiation level in millirem per hour at 1 meter from the external surface of the package or in combination with additional criteria for fissile materials (Reference 2.2).

3.36 Waste Profile Number

The waste profile number is a unique number assigned by a treatment, storage, and disposal facility to a waste stream. An example of a waste profile showing the location of the waste profile number to be included on the WTS is presented in Attachment 6.8.

3.37 Shipped Date

The shipped date is the date on which the waste package was shipped from the LEHR site for final disposition.

3.38 Disposal Date

The disposal date is the date on which the waste package has been certified by the disposal site or treatment, storage, and disposal facility as being disposed.

3.39 Disposal Location

The disposal location is the place where the waste package has been disposed. For example, the name and location of the disposal site or treatment, storage, and disposal facility.

3.40 Previous Package Number

The Previous Package Number represents a package number previously used for the same waste, if for example, it has been re-packaged in another container or consolidated with other waste.

3.41 Notes

This section of the form should be used to include any information that is of interest but not specifically required on the form. For example, additional information about a re-packaged waste might include date/time of re-packaging, condition of original container, and/or any other relevant information about the container or waste.

4.0 PROCEDURE

This section contains the main responsibilities and procedures for the filling out a WTS and maintaining the waste tracking system database. The WTS and database will contain information concerning the waste that will serve as documentation and provide retrieval capabilities for future reference. Each time a waste material is placed into a container, certain information needs to be recorded. Each container is given a unique package number to facilitate tracking.

4.1 Responsibilities

4.1.1 The Waste Coordinator (WC) oversees the waste program and is responsible for the management of waste generated from activities at the LEHR site.

4.1.2 The Field Waste Coordinator (FWC) is responsible for the management of the field waste operations on a daily basis at the LEHR site and reports to the WC. His/her duties include waste identification, segregation, packaging, identification of required waste containers, review of packaging logs, preparation of disposal documents, authorization of container closure and transfer to the waste storage/staging facility, and supervision of Waste Packaging Observers. At the time of generation, a WTS is initiated by the FWC or other qualified designee. The FWC has the overall responsibility of ensuring that the WTSs are completed prior to submitting for entry into the database.

4.1.3 The Waste Packaging Observer (WPO) is qualified to evaluate in-the-field waste classification and to certify packaging correctness.

4.1.4 The Waste Program Database Administrator (DA) is responsible for maintenance of waste tracking system database including accurately transcribing information from the WTS into the waste tracking system database and filing and distributing forms and copies to the appropriate personnel.

4.1.5 The Waste Tracking System Coordinator (WTSC) is responsible for reviewing the WTSs for completeness and accuracy and assuring that this information is properly entered into the waste tracking system database. The WTSC is also responsible for conducting surveillance of waste packaging activities and records.

4.1.6 The Radiological Controls Technicians (RCTs) are responsible for the performance of radiological surveys.

4.1.7 The field personnel of interest (FPI) or designees are responsible for performing all sampling of the waste and are qualified to initiate the documentation that will identify and track waste as described in this procedure. The FPI either fills out the WTS or provides the information to the WPO or FWC who completes the form. The FPI will be designated by the FWC.

4.1.8 The waste generator broker/agents (WB) are responsible for the waste and sign the Certification Statement.

4.2 Waste Tracking Program

4.2.1 Waste generated at the LEHR site requires documentation when the waste is packaged in a discrete amount where it can be differentiated from other materials or waste.

4.2.2 A generated waste package must be assigned a unique identification number so that it may be tracked from the point of generation to ultimate disposal. A durable, weather-proof Waste Tracking Label is affixed to the waste package for that purpose. In the case of a stockpile or other waste configuration where a label is not able to be affixed, a label is fastened to a stake or similar monument and placed in proximity to the waste in order to uniquely identify it. An example of the Waste Tracking Label is shown in Attachment 6.9.

4.2.3 Each uniquely identified waste package must have appropriate documentation including a WTS, an inventory log, and survey data. At the time of generation or at a specified stopping point, a WTS is initiated by the FWC, WPO, FPI or other qualified designee. Directions for filling out the WTS are contained in Section 4.3 of this document.

4.2.4 The FPI either fills out the WTS or provides the information to the WPO or FWC who then completes the form. A copy of the WTS is made and distributed to the WC and FWC for their files and to the FPI/originator's file. The original WTS is sent to the WTSC.

4.2.5 The WTSC reviews the information on the WTS for completeness and accuracy. The WTSC can either return the form back to the FWC to modify and initial any changes on the form or the WTSC can make changes on the form and initial them after obtaining concurrence from the FWC. The WTSC checks the form and validates that relevant and required information has been provided. When the WTSC is satisfied that the information provided is accurately represented on the WTS form, the WTSC delivers the original with any initialed corrections to the DA.

4.2.6 The DA or designee copies the WTS original and transcribes the information on the WTS form into the database within one workday from receipt. The DA files the original by a system which allows for easy retrieval in the future. A copy of the database entry and the WTS form is returned to the WTSC.

4.2.7 The WTSC reviews the database entry copy and compares it to the copy of the WTS form. Any corrections are made on the database copy by the WTSC and returned to the DA for entry in to the database to be completed within one working day. The process may be repeated until the WTSC is satisfied that the information provided is accurately represented on the Waste Tracking System database entry.

4.2.8 The final accepted Waste Tracking System database entry is initialed by the WTSC and returned to the DA who makes copies of the WTS form and the Waste Tracking System database entry and delivers them to the WC, FWC, WPO, WTSC, and the originator or FPI.

4.2.9 Any WTS forms with the update box checked should be handled in a similar manner, but in addition, the WTSC should view a copy of the WTS, evaluate the changes, highlight them on the WTS data entry form before delivering them to the DA.

4.2.10 The DA will make the appropriate changes on the Waste Tracking System database entry noting that it is an update to the original. The data entry process may be repeated as necessary. When the WTSC is satisfied that the information provided is accurately represented on the Waste Tracking System database entry, the WTSC will deliver the final updated WTS form that has been initialed to the DA.

4.2.11 The original updated WTS form should be stapled behind the original WTS form and filed appropriately by the DA.

4.3 Completing the Waste Tracking Sheet

The WTS originator, the FPI, WPO, or the FWC ensures that an adhesive-backed vinyl label has been affixed to the waste and that a WTS form is filled out with the same package number as the label. The individual responsible for completing the WTS in the field (as defined in Section 4.1) will enter “Not Applicable” or “To Be Determined” for mandatory fields. “To Be Determined” should be so indicated if that information is needed but not yet available. Any unknown information should be left blank. This will enable the information to be added easily later as it becomes available. Explanations of information required for completion of the WTS are provided in the Section 3.0 of this document. Forms should be filled out with at least the following information:

- New or Update box checked
- Package Number
- Package Type
- DOT Container Type
- Waste Description
- Maximum Dose Rate

- Hot Spot
- Survey Number
- Date Waste Was Generated
- Origin of Waste
- Storage Location
- Storage Start Date
- External Package Volume
- Internal Package Volume
- Previous Package Number

5.0 RECORDS

5.1 Filing The Waste Tracking Sheets

Original WTS are to be filed in a manner that allows easy retrieval. Original updated WTS should be stapled behind the original new WTS in chronological order. These sheets are considered part of the LEHR permanent records and should be kept in accordance with the LEHR Final Quality Assurance Project Plan (Reference 2.5).

5.2 Generating And Maintaining The Waste Tracking System Database

The waste tracking system database should be maintained current to reflect as best as possible real-time information from the WTS. The information from the WTS should be entered into the database within one workday. Copies of the updated database printout are made available to the FWC and WTSC at that time. A complete printout of the waste tracking system database should be maintained in the central waste tracking system box and waste tracking system binder at all times. The WC receives periodic updates of the database printout. These waste tracking system database printout updates are considered part of the LEHR permanent records and should be kept in accordance with the LEHR Final Quality Assurance Project Plan (Reference 2.5). An example of a waste tracking system database printout is presented in Attachment 6.10.

6.0 ATTACHMENTS

6.1 Example of Waste Tracking Sheet (Form SOP 34-5.A)

6.2 Example of Completed Waste Tracking Sheet

6.3 *Example of Waste Designation Report*

6.4 *Example of Waste Storage/Disposal Record*

6.5 *Example of Bill of Lading*

6.6 *Example of Hazardous Waste Manifest*

6.7 *Example of Radioactive Waste Manifest*

6.8 *Example of Waste Profile*

6.9 *Example of Waste Tracking Label*

6.10 *Example of Waste Tracking Database Printout*

ATTACHMENT 6.1

EXAMPLE OF WASTE TRACKING SHEET (FORM SOP 34.5)

New ❑
Update ❑

Waste Tracking Sheet

Package No.:	**Package Type (see footnote):**
DOT Container Type:	
Waste Description (see footnote):	
Waste Designation (see footnote):	
Compatibility Review Results:	
Hazardous Waste Code:	
Maximum Dose Rate (µR/hr):	**Hot Spot (mR/hr):**
Survey No.:	**Date Waste was Generated:**
Origin of Waste:	
Waste Origination:	
Process Knowledge/History:	
Sample No.(s):	
Laboratory:	
Storage Location:	
Date Sealed:	**Storage Start Date:**
Accumulation Start Date:	
External Package Volume (ft^3):	
Volume of Waste (ft^3):	Total (container & waste) Weight (lbs.):
Internal Package Volume (ft^3):	Container Tare Weight (lbs.):
Pre-disposal Treatment Type:	Treatment Date:
Waste Storage Disposal Record No.:	Portfolio No.:
Shipment No.:	Bill of Lading No.:
Hazardous Waste Manifest No.:	Radioactive Waste Manifest No.:
Transportation Index:	Waste Profile No.:
Shipped Date:	Disposal Date:
Disposal Location:	
Previous Package No.:	
Notes:	

Bold categories are entries which are mandatory.

Initials & Date of Person Completing Form: ____________ **Initials** ____________ **Date**

Initials & Date of Person Entering Form: ____________ Initials ____________ Date

Package Type:

85 gal drum	5 gal carboys
55 gal drum	5 gal bucket
B-25 box	Roll-off bin
B-12 box	1 liter container P or G
Stock pile	Tank

Waste Description: specify %

Void Filler	Debris
Soil	PPE
Gravel	Plastic
Concrete	Decon Water
Metal	Liquid: ____________
Asphalt	Other: ____________

Waste Designation:

TBD	Mixed
Ca-Haz	Transuranic
UT-Haz	Combined
Wa-Haz	RMMA
Haz (RCRA)	Clean
Low Level Rad	
Potentially Mixed Pending Analysis	

ATTACHMENT 6.2

EXAMPLE OF COMPLETED WASTE TRACKING SHEET

New Tracking No. ☑
Update to Previously Entered No. ☐

Waste & Material Tracking System Sheet

(Bold categories are entries which are mandatory for New Package No.)

General Information:

Waste/Material Tracking No.: LEHR1367 | **Previous Tracking No.** (if applicable):

Package Type (see footnote): Lift-Liner | **DOT Container Type:** Strong Tight

Check one: ☑ **Waste** or ☐ **Material** | Check if package is out of service. Note reason in Comments: ☐ Out of Service

Generator Information:

Site Code (ie SWT RA, DSS2, etc.): Ra/Sr Area II

Specific Location/Structure (see key below): Sep II

Waste/Material Description (see key below): Soil 92% Debris 8%

Additional Waste Description: Sanitary Sewer Piping

Waste Generation Date: 8/29/00 | Process Knowledge/History:

Waste Volume (ft^3): 230 | External Container Volume (ft^3): 230 | Internal Container Volume (ft^3): 230

Container Tare Weight (lbs.): | **Total (container & waste/material) Weight (lbs.):** 20810

Sample No.(s): CWRSC093

Analytical Laboratory: GEL

Waste/Material Origin Coordinates (if applicable):

North Start:	**South Start:** 6	**West Start:** 4	**East Start:**	**Starting Depth: (Below Ground Surface)**	4
North Stop:	**South Stop:** 4.75	**West Stop:** 4.5	**East Stop:**	**Ending Depth: (Below Ground Surface)**	4

Storage:

Storage Location: Aisle #6, WDP | **Storage Start Date:** 8/30/00

Maximum Dose Rate (µR/hr): 10 | **Hot Spot (mR/hr):** N/A | **Survey No.:** 083000-001

Accumulation Start Date: 8/29/00 | **Date Sealed:** 8/30/00

Shipping:

☐ Shipped | Shipment No.: | Shipped Date:

Hazardous Waste Manifest No.: | Radioactive Waste Manifest No.:

Bill of Lading No.: | Transportation Index:

Disposal:

Waste Designation (see footnote): TBD

Compatibility Review Results: | Hazardous Waste Code:

Disposal Date: | Disposal Location:

Waste Storage Disposal Record No.: | Waste Profile No.:

Portfolio No.: | Pre-disposal Treatment Type: | Treatment Date:

Comments:

Small amount of bag, ~5%, dedicated to sanitary sewer piping and soil.

Person Filling Out WMTS Sheet: JW (Initials) 9/6/00 (Date) Person Entering Data Into WMTS: PVC (Initials) 9/26/00 (Date)

Package Type:	
55 gal drum	1 gal plastic bucket
85 gal drum	2 gal plastic bucket
B-12 box	5 gal plastic bucket
B-25 box	85 gal bucket
Stock pile	Roll-off bin
Super sack	1 liter container P or G
Tank	Lift liner (LL)

Waste Description: specify %	
Void Filler	Debris
Soil	PPE
Gravel	Plastic
Concrete	Decon Water
Metal	Void Space
Cobble	Liquid:
Asphalt	Other:

Specific Location/Structure:	
Sr Tank	DW2
Ra Tank	DW3
DB	Other:
DW1	

Waste Designation:	
TBD	California Combined
California Hazardous Waste	Transuranic
Federal Hazardous Waste	Haz (RCRA)
LLRW	RMMA
Mixed	Potentially Mixed
Clean	Pending Analysis

WASTE CERTIFICATION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure will provide the guidance necessary to permit the certification of the waste generated during environmental restoration (ER) activities performed at the LEHR site.

This procedure applies to the actions required to ensure that preparation and packaging of LEHR waste which will be shipped directly to the DOE Hanford disposal site meets the disposal site's waste acceptance criteria through the waste certification process described in References 2.1 and 2.2. Minimum actions by the Waste Packaging Observer (WPO) applicable to LEHR waste are listed below:

- Preparation of the documentation necessary for requesting and receiving an approved storage/disposal approval record (SDAR);
- Recognition and segregation of free liquids, (Low Level Waste) Hazardous Waste, and radioactive mixed waste (RMW);
- Verification and documentation of radioactive material content in the waste package, by individual radionuclide; and
- Recognition and exclusion of waste, which is potentially capable of generating harmful gases, vapors and pressures.

2.0 REFERENCES

2.1 *Low-Level Waste Certification Plan for LEHR-UCD, Revision 2, April 1993*

2.2 *SOP 34.1 - "Waste Processing and Packaging"*

2.3 *SOP 34.3 - "Radioactive Waste Shipment"*

2.4 *WHC-EP-0063-4, Hanford Site Solid Waste Acceptance Criteria*

3.0 DEFINITIONS

3.1 ER

Environmental Restoration

3.2 EPA

U.S. Environmental Protection Agency

3.3 LEHR

Laboratory for Energy-Related Health Research

3.4 LLW

Low-Level Waste

3.5 LLWSDR

Low-Level Waste Storage/Disposal Record

3.6 RMWAS

Radioactive Mixed Waste Attachment Sheet

3.7 RMW

Radioactive Mixed Waste

3.8 SDAR

Storage/Disposal Approval Record

3.9 WAC

Waste Acceptance Criteria

3.10 WSDR

Waste Storage/Disposal Request

3.11 WSF

Waste Staging Facility

4.0 RESPONSIBILITIES

4.1.1 The Site H&S Officer (SHSO) will be responsible for the timeliness and accuracy of radiological information required for waste certification.

4.1.2 The Field Coordinator will be responsible for ensuring that waste processing and packaging activities are performed under the surveillance of the WPO or Waste Coordinator (Wco).

4.1.3 The WCo will be responsible for the completion of the WSDR, and for the necessary observations, evaluations, and calculations leading to the certification of all wastes to be disposed. The WCo will ensure the applicability and accuracy of documented information received from the WPO and SHSO, which will provide the basis for waste certification. The WCo will complete the LLWSDRs, RMWAS (for RMW) and shipping papers (see Reference 2.3) in preparation for the waste certification official's signature.

4.1.4 The Radiological Control Technicians are responsible for conducting all radiation, contamination, and airborne surveys during the performance of this procedure.

4.1.5 Work personnel are responsible for performing the work outlined in this procedure in accordance with its requirements and those of the applicable HWP.

5.0 PRECAUTIONS

5.1.1 Ensure that waste containers have lockable lids.

5.1.2 Partially filled waste containers must be locked closed when unattended.

6.0 PREREQUISITES

6.1.1 Complete descriptions of the contents of each packet/unit of waste will be documented before it is containerized.

6.1.2 Ensure that the WPO is present before waste packaging operations start.

6.1.3 Have an approved SDAR available, and include its contained information in the pre-work training.

7.0 PROCEDURE

Preparation of the documentation for requesting an approved SDAR shall be completed by the WCo well in advance of institution of waste processing activities. The waste certification process will utilize evaluation of waste records by the WCo and physical observations of the waste by the WPO as it is being processed and/or loaded into the container. Radiological information will be received by the SHSO from the Radiological Control Technicians in the form of documented analyses and survey results. Physical descriptions of waste units (packets, demolition debris, equipment, etc.) which comprise the waste container's contents will be documented by the WCo on the LLWSDR. All waste certification activities will be performed in accordance with Reference 2.1 (Hanford WAC).

7.1 Preparation of Waste Storage/Disposal Request

The Waste Storage/Disposal Request and its attachment will be properly completed by the WCo, utilizing the Instructions accompanying the Request Form (Reference 2.1). The representative of the shipper will sign the completed request and forward it to the DOE Hanford waste disposal site to permit subsequent issue of the required SDAR.

7.2 Hazardous Material Identification and Segregation

7.2.1 If a waste packet to be containerized is packaged so that its contents are not discernible, a written description of the packet's contents must have been previously generated by the WPO, based on his surveillance (see Reference 2.4, Section 7.3.7). This description will provide the basis for assurance of its nature.

7.2.2 If a waste unit to be containerized cannot be positively identified by the WPO as non-hazardous, it will be excluded from packaging and set aside for further evaluation. Characteristics to look for include the following:

- Evidence of moisture or free liquid.
- Waste showing unexplained discoloration or corrosive effects or chemical action.
- Caustic or acid odors.

7.2.3 For wastes designated as RMW, a RMWAS shall be completed in accordance with the instructions contained in Reference 2.1.

7.3 General

Waste preparation, packaging, and sealing will meet the specific criteria contained in the SDAR. Typical subjects may include use of absorbents and void volume fillers, required internal liners, closure mechanisms, special marking and labels, maximum package weight.

7.4 Radiological Criteria

7.4.1 Total radionuclide content of the loaded waste containers will be calculated by the SHSO from analyses/surveys supplied by the Radiological Control Technicians for each packet and unit (e.g., equipment, hardware, demolition debris) identified and entered on the LLWSDR (Reference 2.1).

7.4.2 Radiation and contamination levels associated with the loaded and sealed container will be measured and documented by the attending Radiological Control Technicians and supplied to the WCo, to be added to the data packet accompanying the loaded container to the WSF.

8.0 ATTACHMENTS

None.

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

WASTE CHARACTERIZATION FOR OFF-SITE SHIPMENT

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes the methodology for characterizing waste for off-site shipment and disposal. The work includes a methodology for documenting process knowledge and selecting additional analysis needed to fully characterize the waste to meet the waste acceptance criteria (WAC) of the off-site disposal facility. This procedure also describes the responsibilities of project personnel, health and safety considerations, references, and documentation requirements associated with waste characterization.

1.1 Scope

The scope of this procedure addresses the following:

- Documenting pre-characterization information including process knowledge,
- Selecting a representative sample set for waste characterization and sampling, and
- Packaging the samples for shipment to the analytical laboratory.

2.0 REFERENCES

2.1 *Final Project Health and Safety Plan, Rev. 3, June 2000*

2.2 *49 Code of Federal Regulations 173, Shippers General Requirements for Shipment and Packaging*

2.3 *Standard Operating Procedure (SOP) 1.1, Chain-of-Custody*

2.4 *SOP 2.1, Sample Handling, Packaging and Shipping*

2.5 *SOP 25.1, Radiological Surveys and Instrumentation*

2.6 *SOP 34.1, Waste Processing and Packaging*

2.7 SOP 34.3, Waste Shipment

2.8 Addendum to Sampling and Analysis Plan for Chlordane Stockpile Characterization, Weiss Associates, 1998

3.0 DEFINITIONS

3.1 10-Point Composite

One sample that is derived from 10 discrete sampling locations

3.2 Waste Acceptance Criteria

A set of requirements that must be met in order for the receiving site to accept the waste.

4.0 RESPONSIBILITIES

4.1 Project Manager

The Project Manager (PM) is responsible for implementing the waste management program, providing adequate staff to perform the activities described herein, ensuring that staff have required training, and providing the necessary equipment to carryout the required waste management duties.

4.2 Radiological Controls Technician

The Radiological Controls Technician (RCT) is responsible for the performance of radiological surveys, implementation of Hazardous Work Permits (HWPs), air monitoring and other health and safety duties as assigned.

4.3 Field Personnel

Field Personnel are responsible for performing waste sampling, as assigned, and may provide the Waste Packaging Observer (WPO) or WC with required information so they can complete the waste and material sheet.

4.4 Waste Coordinator

The Waste Coordinator (WC) is responsible for the day-to-day implementation of the WMP at the Site and reports to the LEHR PM. The WC's primary responsibilities include waste identification, segregation and packaging, including selection of required waste containers, review of packaging logs, preparation of disposal documents; authorization of container closure and transfer to the waste storage/staging facility, supervision of the WPOs, and oversight of waste characterization sample collection. At the time of waste generation, the WC initiates a Waste Material Tracking System (WMTS) sheet. The WC has the overall responsibility for ensuring that the WMTS sheets are completed properly prior to submission to the Site Records Administrator (SRA) for entry into the WMTS) database.

4.5 Waste Specialist

The Waste Specialist (WS) is responsible for defining the sampling frequency for project waste streams, evaluating analytical data, designating project waste streams, and completing waste profiles. The WS coordinates with selected waste disposal facilities in order to fulfill WAC specific to the waste disposal site. These activities include, but are not limited to the following: providing completed waste profiles or summaries and coordinating shipping logistics between the waste disposal facility and the Waste Broker.

5.0 HEALTH AND SAFETY CONSIDERATIONS

The Project Health and Safety Plan (PHSP) addresses the hazard analysis and controls associated with waste characterization activities. An Activity Hazard Analysis and HWP should be completed and in place prior to performing characterization activities.

5.1 Training

5.1.1 All personnel working on the sampling tasks associated with this procedure will have been trained in accordance with the requirements of the PHSP and associated other related safety documents such as an Activity Hazard Analysis.

5.1.2 At the beginning of each workday, a tailgate safety meeting will be conducted and documented on the Tailgate Safety Meeting form (Health and Safety Form 1.1). As a minimum, the details of the expected work activities, site evacuation route(s), emergency actions, hazards associated with the sampling operations, and the requirements of the PHSP and the HWP will be discussed during the meeting.

6.0 PROCEDURE

The primary objective of waste characterization is to use all available information to allow for proper classification/designation of the waste prior to being shipped for final disposal.

6.1 Characterization Requirements

The first step in characterizing a waste stream is to research and document available information about the waste including, but not limited to, the following:

- Waste origin,
- Process that generated the waste,
- Waste matrix,
- Physical description of the waste,
- Volume of waste (including stabilization or absorbent media),
- Weight of waste (including container),
- Possible radiological or chemical constituents,
- Radionuclide activity and composition,
- Dates of characterization ,
- Date of generation, and
- Any other information required to meet on-site storage and disposal site WAC.

This information is documented in the WMTS as required by SOP 34.5.

Since each waste stream is unique and the amount of available process knowledge varies, there is no standardized protocol for the analyses that will be required to meet the disposal site WAC. However, there are some minimum disposal site-specific requirements that must be met. Specific characterization requirements will need to be documented in individual work plans or equivalent documents.

The following guiding principles shall be employed in the development of the characterization work plan or equivalent document protocols:

- Waste characterization is directly correlated to the confidence in and the amount of process knowledge and prior characterization data;

- The waste characterization shall meet the known requirements of the anticipated waste disposal facility;

- A docket or document shall be assembled of all relevant documentation or processed knowledge of the waste and its origin; and,

- The waste characterization shall have sufficient detection limits to ensure compliance with state, federal, and disposal site requirements.

Table 8-1 in Attachment 8-1 provides a list of the typical analytical test methods used to characterize a waste stream. Some analyses may be waived depending on the waste composition and process knowledge evaluation. Additional analyses may also be required depending on the results from analytical tests or process knowledge indicating that a constituent of concern may be present that would not be detected by the methods shown in Table 8-1 in Attachment 8-1.

6.2 Sample Frequency

6.2.1 Suspected Clean Waste - Material presumed to be clean based on process knowledge and on-site lab analysis which is planned for re-use on site (i.e., as backfill) shall be sampled at a rate of one 10-point composite sample per 50 cubic yards of soil. Stockpile sampling will be performed as defined in the Addendum to Sampling and Analysis Plan for Chlordane Stockpile Characterization (Reference 2.8).

A 10-point composite sample will be collected per 50 cu yds for soil as indicated below:

- Discrete samples will be collected using a clean trowel from a two-dimensional grid system overlying the stockpile;
- Discrete sample locations will be determined using a random number generator;
- Discrete samples will be collected from within 6 inches of the stockpile surface; and,
- Samples from all 10 locations will be combined into a single sample.

6.2.2 Suspected Contaminated Waste – All information previously gathered about a waste stream should be used in assigning a sampling frequency. Since every waste stream is unique, there is not one prescribed protocol that can be indicated as a set standard which provides sufficient flexibility for determining appropriate characterization methods. The WS and the WC will evaluate the available information on a waste stream and derive a sampling frequency that meets the disposal facilities WAC. The derived sampling plan including frequency will be documented in a work plan, sampling plan or equivalent document.

6.3 Sample Shipment and Analysis

6.3.1 Chain-of-Custody (COC) forms will be completed to track sample custody as well as to specify the requested analyses. COC forms will be completed in accordance with the requirements of SOP 1.1, Chain-of-Custody (Reference 2.3).

6.3.2 All samples sent off site for analysis will be packaged and shipped according to the instructions provided by the analytical laboratory, and SOP 2.1, Sample Handling, Packaging & Shipping (Reference 2.4).

7.0 DOCUMENTATION/RECORDS

All records related to this procedure which includes chain of custody forms, field log books, and analytical results, will be maintained in accordance with the Final Quality Assurance Project Plan.

8.0 ATTACHMENTS

8.1 Typical Field and Laboratory Analytical Methods for LEHR Waste Characterization

ATTACHMENT 8.1

TYPICAL FIELD AND LABORATORY ANALYTICAL METHODS FOR LEHR WASTE CHARACTERIZATION

Table 8-1. Typical Field and Laboratory Analytical Methods for LEHR Waste Characterization

Parameter	Analytical Method	Required Detection Limit (pCi/g for radionuclides, mg/kg for Metals/General Chemistry, µg/kg for Organics)
<u>Driver COCs</u>	**Field**	
Radium-226	Gamma Spectroscopy/HPGe Screening	1
Strontium-90	Proprietary Beta Scint, Inc. Scintillation	10
Chlordane	Immuno-assay, EPA Method 4041	0.7
<u>Full Suite of COCs</u>	**Laboratory**	
<u>Radionuclides:</u>		
Americium-241	Lab SOP	0.01
Carbon-14	Lab SOP	0.1
Gamma Emitters	EPA Method 901.1	
Actinium-228	EPA Method 901.1	0.1
Bismuth-212	EPA Method 901.1	0.1
Bismuth-214	EPA Method 901.1	0.1
Cesium-137	EPA Method 901.1	0.01
Cobalt-60	EPA Method 901.1	0.005
Lead-210	EPA Method 901.1	0.5
Lead-212	EPA Method 901.1	0.1
Lead-214	EPA Method 901.1	0.1
Potassium-40	EPA Method 901.1	1
Radium-223	EPA Method 901.1	2
Radium-228	EPA Method 901.1	0.1
Radium-226	EPA Method 901.1	0.1
Thallium-208	EPA Method 901.1	0.05
Thorium-234	EPA Method 901.1	0.5
Gross Alpha	EPA Method 9310	1
Gross Beta	EPA Method 9310	1
Plutonium-241	Lab SOP	0.5
Strontium-90	EPA Method 905.0	0.05
Thorium-228	Lab SOP	0.1
Thorium-230	Lab SOP	0.05
Thorium-232	Lab SOP	0.05
Tritium	EPA Method 906.0	1
Uranium-233/234	Lab SOP	0.025
Uranium-235	Lab SOP	0.01
Uranium-238	Lab SOP	0.025
<u>Metals:</u>		
Antimony	EPA Method 6010	0.5
Arsenic	EPA Method 6010	2
Barium	EPA Method 6010	40
Beryllium	EPA Method 6010	1
Cadmium	EPA Method 6010	0.25
Chromium (total)	EPA Method 6010	1
Cobalt	EPA Method 6010	10
Copper	EPA Method 6010	0.25

Table 1. Typical Field and Laboratory Analytical Methods for LEHR Waste Characterization (Continued)

Parameter	Analytical Method	Required Detection Limit (pCi/g for radionuclides, mg/kg for Metals/General Chemistry, µg/kg for Organics)
Iron	EPA Method 6010	20
Lead	EPA Method 6010	0.3
Manganese	EPA Method 6010	3
Mercury	EPA Method 7471	0.1
Molybdenum	EPA Method 6010	0.1
Nickel	EPA Method 6010	1
Selenium	EPA Method 6010	1
Silver	EPA Method 6010	0.1
Thallium	EPA Method 6010	0.5
Vandium	EPA Method 6010	1
Zinc	EPA Method 6010	4
General Chemistry:		
Chromium VI	EPA Method 3060A/7196	0.05
Nitrate (as Nitrogen)	EPA Method 300.0	1
Total Organic Carbon	EPA Method 415.1	100
Ammonia	EPA Method 350.1	1
Total Kjeldahl Nitrogen	EPA Method 351.2	2
Formaldehyde	Modified NIOSH 3500/AOAC 20.062	0.2
pH	SW-846 Method 9045	0.01 (pH unit)
Reactivity with Cyanide	SW-846 Chapter 7	0.02
Reactivity with Sulfide	SW-846 Chapter 7	0.02
Ignitability	SW-846 Modified 1020A or 1010 (210°C)	Not Applicable
Paint Filter Test	SW-846 Method 9095	Not Applicable
Total Plate Count	Standard Method, 17th Ed., 9215	Not Applicable
Organics:		
Volatile Organic Compounds	EPA Method 8260	As specified in method
	9	
Semi-Volatile Organic Compounds	EPA Method 8270	As specified in method
Organochlorine Pesticides/PCBs	EPA Method 8080	As specified in method
Herbicides	EPA Method 8151	As specified in method

Abbreviations:
COCs constituents of concern NIOSH National Institute of Occupational Safety and Health
EPA United States Environmental Protection Agency pCi/g picoCuries per gram
HPGe high-purity germanium µg/kg micrograms per kilogram
mg/kg milligrams per kilogram

TENNELEC SERIES 5 LOW BACKGROUND COUNTING SYSTEM

STANDARD OPERATING PROCEDURE

1.0 INTRODUCTION

Gas flow proportional counting is recognized as one of the most practical methods for performing gross alpha and/or beta measurements. Measuring the gross radioactivity in a sample provides a simple direct method for screening samples. Most of the natural and man-made radionuclides of interest decay by alpha emission or beta decay. Their detection in the proportional counter can be correlated to the number of atoms decaying in the sample per unit time that is, by definition, the activity.

There are many significant advantages to using a gas-flow proportional system for gross quantitative measurements. The selection of this technique is often related to the types of samples to be measured. Considerations for sample preparation, sample size, desired detection limit, and post-process wastes are also significant issues underlying the choice of the counting method. Gas flow proportional counting systems are capable of providing accurate radioactivity measurements, at and below naturally occurring levels, for a variety of sample types.

1.1 Purpose

The purpose of this document is to provide personnel operating the Tennelec Series 5 low background counting system (TS5) and personnel who support those operations with one procedure for the instrument's operation. This will ensure the quality and continuity of data, and minimize duplicate efforts.

1.2 Applicability

This procedure is applicable to all LEHR site personnel, contractors and subcontractors using the TS5 for the purposes specified in this procedure.

1.3 Responsibilities

All personnel operating the TS5 are responsible for adherence to the requirements of this procedure.

1.3.1 Instrument Custodian

The TS5 is the property of the United States Department of Energy (DOE). DOE shall appoint one person who shall be responsible for the following:

Maintenance of the instrument by the manufacturer or equivalent technical personnel.

Ensuring that only appropriately trained or supervised personnel are permitted to utilize the instrument. This shall be verified through observation by the instrument custodian.

Accountability for radioactive sources associated with the instrument

Controlling storage, handling and disposal of sample material after use in accordance with section 7.2 and reference 9.3.

1.3.2 Operators

All personnel who will utilize the TS5 in the performance of their duties are responsible for:

Operating the instrument in accordance with the requirements of this procedure.

Keeping the laboratory clean and free of contamination.

Properly segregating samples after analysis into contaminated and non contaminated disposal locations.

2.0 FACTORS AFFECTING SAMPLE MEASUREMENTS

There are several factors that can directly affect the quality of results using a gas flow proportional counter. The following are some of the most common factors.

2.1 Gas Composition and Quenching

While many gases work in an ionization detector, this is not true for proportional detectors. The quality and composition of counting gas has a direct effect on the performance of the counter. In proportional detectors, the output signal is derived from the collection of free electrons. Any creation of negative ions competes with free electron production and collection; therefore affects the proportionality of the output pulses. The fill gas must not contain any molecular gas components that are strong electron attractors that form anions. The noble gases are ideal for proportional detectors.

Another consideration in the selection of the counting gas for proportional detectors is that secondary Townsend avalanches are infrequent. These secondary avalanches result when ultraviolet photons produced by atomic de-excitation occurs in the gas. The addition of a quenching agent, usually a polyatomic gas such as methane that is added to the argon gas, suppresses further ionization from excited gas atoms. The quenching agent absorbs the UV photons and then de-excites by dissociation or radioactive modes of de-excitation that do not result in localized avalanches in the gas. As discussed above, when these secondary avalanches do occur, they may result in higher background or spurious counts in the detector. The most commonly used counting gas, P-10, utilizes this principle in its 90% argon and 10% methane mixture.

2.2 Background Radiation

The background radiation levels associated with both the instrument's environment and other background radiations associated with events taking place outside the sample itself will have an affect on the instruments performance. The following is a discussion of the means by which this affect is minimized.

2.2.1 Voltage Discrimination

The counting gas is not sensitive to fast electrons as it is to alphas and heavily charged particles; therefore, operating the detector at the alpha plateau voltage results in beta output pulses that do not exceed the counting voltage threshold. Under these conditions, many possible sources of background are eliminated. The observed background in a proportional detector is a function of the threshold setting that defines the minimum ionization required for a count to be recorded.

2.2.2 Environmental Background Radiation

Another phenomenon which influences all counting is the inevitable background produced by environmental radiation. Several sources of radiation can affect the sensitive scintillation solution and the detection process.

- Cosmic radiation which is variable and influenced by sun spot activity and barometric pressure.
- Fallout from nuclear tests which might be contained in the air.
- The building materials of the laboratory which contain radioactivity.
- Natural radioactivity in detector materials, associated equipment, supports, shielding and circuitry near the detector.
- Stray radiation from sources of activity in the laboratory, or apparatus producing radiation such as x-rays or magnetic fields.

The sample in the counting chamber and the gas flow proportional detector is surrounded by lead, typically about two inches (5 cm) in all directions. This lowers the background to reasonable proportions for all but very low activity measurements.

The instrument should optimally be installed away from all sources of radiation, including magnetic sources. It is permissible to store small check sources of low activity in the same room as the instrument so long as they are not stored immediately adjacent to the instrument.

2.3 Sample and Guard Detectors

The sample detector is a 2.25 inch diameter pancake style gas-flow proportional detector. The detector features twin anodes for excellent counting uniformity and an ultra-thin 80 g/cm^2 entrance window for high counting efficiency.

The guard detector is a large-area gas-flow proportional detector with six anode wires for excellent counting uniformity. The bottom of the guard detector is contoured to encompass the sample detector, thus reducing the exposure of the sample detector to un-guarded external background sources.

2.4 User Specified Parameters

2.4.1 Count Time

Both the length of count and the number of counts per sample will affect the outcome of the analysis. A longer count time will result in a decrease in the Lower Limit of Detection (LLD), and subsequent Minimum Detectable Activity (MDA), achieved during the analysis. Increasing the number of counts associated with an individual sample will increase the level of confidence associated with that sample analysis.

Count times and the number of times to count each sample are specified in section 5 for those individual analysis.

3.0 OPERATION

3.1 Equipment

The following equipment will be required for the performance of the analysis described in this procedure. Additional equipment may be required if additional analysis are to be performed.

3.1.1 Tennelec Series 5

This procedure has been written for use of the Oxford Instruments Tennelec Series 5 Gas Flow Proportional Counting System. If another type of gas flow proportional counting system is to be used, this procedure should be changed to reflect the equipment used.

Prior to use, the TS5 shall be installed by qualified personnel in accordance with the manufacturers instructions and in a location described in section 2.2.2.

3.1.2 Standards

Electroplated standards for both beta and alpha radiations are required for the performance of High Voltage Plateaus, Efficiency Analysis and daily source checks. Standards will be selected based on nuclides of interest.

Standards should be checked annually for leakage of source material. Standards should be handled carefully to minimize scratching which may lead to source material leakage.

3.1.3 Sample Media

For surface activity measurements, a media which is wiped over the surface being assayed is needed. This media is typically a 47 mm cloth swatch or similar material.

3.2 Precautions

The following precautions are to be observed during the performance of all activities associated with this procedure.

3.2.1 Radiological Controls

Since the analysis described in this procedure are being performed to determine the level of radioactive content in a sample media, standard radiological control practices specified in reference 9.4 shall be used to control worker exposures and the potential spread of radioactive contamination during sampling operations.

3.3 Prerequisites

3.3.1 Instrument Setup

Prior to use, the instrument shall be installed by qualified personnel in accordance with the manufacturers instructions. A high voltage plateau, efficiency count procedure and efficiency regions of interest shall be performed in accordance with section 4.1 of this procedure.

3.3.2 Establishing Counting Procedures

Procedures shall be created for use during analysis are described in section 5. These procedures specify how the instrument controls the counting of individual sample sets and defines parameters to be applied to that sample's analysis. The parameters to be included in the counting procedure associated with the individual analysis are described in section 5.

3.4 Sample Collection

Samples shall be collected in accordance with the requirements of the procedures which direct them to be taken.

Samples shall be prepared in an area and in a manner which minimizes the chance of cross contamination of samples and surfaces. Radiological controls procedures to be followed when handling potentially radioactive materials are specified in reference 9.4.

3.5 Sample Counting

All samples will be field checked prior to being counted by the TS5. Once collected, samples shall be placed on metal planchets and on sample carrier(s), for loading in the instrument. A Group plate

must precede all samples placed onto right sample carrier holder for counting. An end plate **must** be placed after the last sample carrier of a particular survey.

Double click the Eclipse icon on the Windows 95 desktop. Click the title Procedure located on the title bar. A drop down window will appear, chose Select. Another window will appear. On the left side of window is the Group column, select the group associated with the samples to be counted. Next, select the procedure to be used for sample analysis, then select the appropriate sample reporting format. **NOTE: The Eclipse software will select a default reporting format. This reporting format has been modified to meet the LEHR Project reporting criteria.** Click the OK button when finished. To start the sample counting routine selected click the GO button on the toolbar.

4.0 PERFORMANCE VERIFICATION

4.1 Calibration

Calibration of the TS5 is required prior to its use. Refer to reference 9.1 Chapter 10 on the correct calibration procedure. Additionally, any changes in the instrument location, large verifiable changes in ambient background or repairs to the instrument will require a new calibration.

4.2 Daily Source and Background Checks

Performance of the instruments response to ambient background and known calibration standards will be performed in accordance with LEHR RPP. A set of three planchets have been set aside for daily checks. Each of the three planchets are marked with indelible ink on the bottom; one for the beta standard, one for the alpha standard, and one for background. These planchets will be stored in a zip lock style container in a secure location to prevent use for routine smear counting.

4.2.1 Performance of Daily Checks

Retrieve the standards from the source cabinet. Place the standards in the appropriate planchet. NOTE: One planchet should be empty. Place the three planchets in to sample carriers. Select the Group A plate and place it on the right side carrier holder. Place the three planchets on top of the group A plate. Place an End plate on the last planchet. It is not important which planchet, source or background, is counted first.

Double click the Eclipse icon on the Windows 95 desktop. Click the title Procedure located on the title bar. A drop down window will appear, chose Select. Another window will appear. On the left side of window is the Group column, select the Group A. Next, select Daily Source and Background Check. Place a check mark in the box next to Print Report Automatically. **NOTE: The Eclipse software will select a default reporting format. This reporting format has been modified to meet the LEHR Project reporting criteria.** Click the OK button when finished. To start the sample counting routine selected click the GO button on the toolbar.

Data from daily source and background checks will be recorded on the appropriate forms stored in the Daily Instrument Checklist binder. Any unsatisfactory reading will require and additional performance of the daily checks. If three unsatisfactory readings are reported, notify the instrument custodian. **NOTE: The TS5 shall not be used until all corrective actions have been completed as verified by the instrument custodian.**

4.3 Level of QA

Analytical options available to support data collection activities are typically presented in five general categories. Of these, only two will apply to analysis associated with using the TS5. These are described below.

4.3.1 Level II - Field Analysis

This level is typically characterized by the use of portable analytical instruments which can be used in field laboratories. Depending upon the types of contaminants, sample matrix, and personnel skills, both qualitative and quantitative data can be obtained. This level of quality will be applicable to most analysis performed using the LEHR Site TS5.

4.3.2 LEVEL IV - Contract Laboratories Services

In the event that the procedures directing the performance of the samples described in this procedure require, additional outside validation of duplicate samples may be analyzed to this level of quality.

5.0 5.0 SCOPE OF USE

This document describes the procedures to be followed when utilizing the TS5 for specific analysis. This section will delineate those specific analysis and direct the operator how to utilize this procedure to perform those analysis.

5.1 Analysis of Smears

This section will describe the procedures to be followed during the performance of the above named analysis.

5.1.1 Creating a Procedure

A counting procedure for routine smear counting has been created in accordance with section 12 of reference 9.1.

5.1.2 Sample Preparation

Samples will be carried to the LEHR Count Room in a closed zip lock style bag. Samples shall be placed onto metal or paper planchets in an area designated by the instrument Custodian. Planchets containing samples will be placed on TS5 sample carriers in the order in which the samples were collected. TS5 sample carriers are number coded 1-100, it is important to use sample carriers with sequential numbering.

5.1.3 Instrument Operation

Ensure the TS5 is setup and operating as described in section 3.3 and that a daily source and background check has been performed within the past 23 hours. Review the daily source and background check data to ensure that the instrument is operating within specification and in accordance with additional requirements specified in procedures directing the use of the instrument. Performance of daily checks are discussed in section 4 of this procedure.

Double click the Eclipse icon on the Windows 95 desktop. Click the title Procedure located on the title bar. A drop down window will appear, chose Select. Another window will appear. On the left side of window is the Group column, select the Group whose plate will precede samples. Next, select Routine Smears. Place a check mark in the box next to Print Report Automatically. **NOTE: The Eclipse software will select a default reporting format. This reporting format has been modified to meet the LEHR Project reporting criteria.** Click the OK button when finished. To start the sample counting routine selected click the GO button on the toolbar.

Verify printer is online and has sufficient paper.

NOTE: INFORMATION CONCERNING SAVING SAMPLE DATA IS CONTAINED IN SECTION 6.2. SAMPLE DATA SHOULD BE SAVED WHEN PERFORMING SURVEYS IN ACCORDANCE WITH REFERENCE 9.2.

5.2 Analysis of Air Samples

This section will describe the procedures to be followed during the performance of the above named analysis.

5.2.1 Creating a Procedure

A counting procedure for Air Sample counting has been created in accordance with section 12 of reference 9.1.

5.2.2 Sample Preparation

Samples will be carried to the LEHR Count Room in a closed zip lock style bag. Samples shall be placed onto metal or paper planchets in an area designated by the instrument Custodian. Planchets containing samples will be placed on TS5 sample carriers in the order in which the samples were collected. TS5 sample carriers are number coded 1-100, it is important to use sample carriers with sequential numbering.

5.2.3 Instrument Operation

Ensure the TS5 is setup and operating as described in section 3.3 and that a daily source and background check has been performed within the past 23 hours. Review the daily source and background check data to ensure that the instrument is operating within specification and in accordance with additional requirements specified in procedures directing the use of the instrument. Performance of daily checks are discussed in section 4 of this procedure.

Double click the Eclipse icon on the Windows 95 desktop. Click the title Procedure located on the title bar. A drop down window will appear, chose Select. Another window will appear. On the left side of window is the Group column, select the Group whose plate will precede samples. Next, select Air Samples . Place a check mark in the box next to Print Report Automatically. **NOTE: The Eclipse software will select a default reporting format. This reporting format has been modified to meet the LEHR Project reporting criteria.** Click the OK button when finished. To start the sample counting routine selected click the GO button on the toolbar.

Verify printer is online and has sufficient paper.

6.0 DATA STORAGE

Since the OXFORD TS5 is a computer processor based instrument, information associated with both data quality and individual sample data may be stored on both electronic and physical media.

6.1 Printing and Storage of QA Data

QA data associated with the systems performance can be accessed by starting the Eclipse program and selecting File and then selecting Open. All files associated with the Eclipse program will be displayed in the drop down window. To open the QA file either double click the appropriate file name or highlight the file name by clicking the appropriate file and then selecting OK. The results of individual High Voltage Plateaus and Efficiency Counts are stored on the system's primary hard drive under the Eclipse sub-directory. The resultant information from each High Voltage Plateau and Efficiency Count shall be printed and retained in a binder by the instrument's custodian for future reference. To print the QA data, open the appropriate file as described above and click the printer icon located on the toolbar.

6.2 Printing and Storage of Sample Data

Results of the sample analysis will be printed automatically by the instrument, when directed by the operator, as the samples are analyzed using the external printer.

Data associated with a specific sample analysis may be retained for future use by copying it to disk with the external disk drive. This shall be performed when required by the procedures initially directing the samples to be obtained.

7.0 CONTROL OF SAMPLES AFTER ANALYSIS

In order to properly minimize the production of radioactive wastes, any samples identified during analysis as being contaminated shall be handled and segregated as described below.

7.1 Responsibilities

The instrument custodian is responsible for control and disposal of samples and sample containers.

Personnel operating the instrument are responsible for controlling their samples after use in accordance with the requirements of this procedure.

7.2 Sample Controls

Samples which are identified during analysis as containing radioactive materials in excess of site limits shall be placed in the location designated by the instrument custodian for contaminated samples. In order to track the cumulative activity of the samples requiring disposal, the sample shall be placed into a zip-lock style bag and marked indicating it's identity and contents. A copy of the sample results shall be placed in a secure storage location determined by the instrument custodian. These samples shall be handled and disposed of in accordance with the requirements specified in reference 9.3.

Samples which are identified during analysis as not containing radioactive materials shall be placed in the location designated by the instrument custodian for non contaminated samples. These samples shall be disposed of by the instrument custodian in accordance with LEHR procedures.

The instrument custodian shall initiate appropriate steps to ensure the proper disposal, handling, segregation and storage of samples. This may include:

- Posting written instructions in the vicinity of the instrument identifying storage locations and associated requirements.
- Performing periodic recounts of samples from both the contaminated and non-contaminated storage locations to verify analytical data.
- Monitoring the use of the instrument by site personnel.

8.0 RECORDS

Records generated as the result of operations associated with this procedure shall be retained in accordance with the following requirements:

- Results of High Voltage Plateaus and Efficiency Counting data shall be retained by the instrument custodian in a binder located in the vicinity of the instrument. The last year's data shall be retained in this manner. Previous year's data shall be retained in accordance with LEHR project records procedures. Copies of this quality related data shall be made available to personnel using the instrument for inclusion in contractor project records.
- Results of sample analysis shall be retained in accordance with the requirements of the procedure(s) requiring the use of the instrument.

9.0 REFERENCES

9.1 *OXFORD Instruments, "Series 5 HP & XLB Instrument Operations Manual Version 1.17", 1997*

9.2 *U.S. NRC, "NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination", June 1992*

9.3 *PNL/LEHR, "Waste Management Plan for the Laboratory For Energy Related Health Research", March 1994*

9.4 *D.O.E./LEHR, "LEHR Radiological Control Manual", July 1993*

LIQUID SCINTILLATION COUNTER (LSC)

STANDARD OPERATING PROCEDURE

1.0 INTRODUCTION

Liquid Scintillation Counting today is the most sensitive and widely used technique for the detection and quantification of radioactivity. This measurement technique is applicable to all forms of nuclear decay emissions (alpha and beta particle, electron capture, and gamma ray emitting radionuclides). Liquid scintillation counting is an analytical technique in which a sample is combined with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into emitted photons. These photons are subsequently detected by opposing photomultiplier tubes enclosed within a light-tight detection chamber. This chamber is constructed of lead to reduce the effects of external radiation. The pulses from the photomultiplier tubes (PMT), are accumulated in the Spectralyzer™ spectrum analyzer circuit and stored. This spectrum of the sample is then analyzed in 4,000 linear channels for visual presentation and quantification.

1.1 Purpose

The purpose of this document is to provide personnel operating the Liquid Scintillation Counter and personnel who support those operations with one procedure for the instrument's operation. This will ensure the quality and continuity of data, and minimize duplicate efforts.

1.2 Applicability

This procedure is applicable to all LEHR site personnel, contractors and subcontractors using the LSC for the purposes specified in this procedure.

1.3 Responsibilities

All personnel operating the LSC are responsible for adherence to the requirements of this procedure.

1.3.1 Instrument Custodian

The LSC is the property of the University of California, Davis (UCD). UCD shall appoint one person who shall be responsible for the following:

- Maintenance of the instrument by the manufacturer or equivalent technical personnel
- Ensuring that only appropriately trained or supervised personnel are permitted to utilize the instrument. This shall be verified through observation by the instrument custodian.

- Accountability for radioactive sources associated with the instrument
- Controlling storage, handling and disposal of sample vials after use in accordance with reference 9.3.

1.3.2 Operators

All personnel who will utilize the LSC in the performance of their duties are responsible for:

- Operating the instrument in accordance with the requirements of this procedure.
- Keeping the laboratory clean and free of contamination.
- Properly segregating samples after analysis into contaminated and non contaminated disposal locations.

1.4 Definitions

Automatic Efficiency Control - A method used by the Tri-Carb LSC to compensate for the effect of quenching on the sample spectrum. AEC extracts the equivalent keV data for the specified region from the Spectralyzer spectrum analyzer. AEC is based on TSIE or SIE.

Chemiluminescence - Random single photon events generated because of the chemical interaction of sample components. The coincidence circuit excludes most chemiluminescent events except at high rates.

Chemical Quenching - A reduction in scintillation intensity seen by the photomultiplier tubes due to materials present in the scintillation solution interfering with the process leading to the production of light. The result is fewer photons per kev of beta particle energy and usually a reduction in counting efficiency.

Coefficient of Variation - The ratio of the standard deviation of a distribution to its arithmetic mean.

Dual Label - Two different radionuclides in a sample.

Efficiency Tracing - A technique that uses spectral distribution analysis to calculate certain absolute activities of the sample at 100% efficiency.

External Standard - A radioactive source placed adjacent to the liquid standard to produce scintillations in the sample thus monitoring the sample's level of quench.

Figure of merit - A term applied to a numerical value used to characterize the performance of a system. In liquid scintillation counting, specific formulas have been derived for quantitatively comparing certain aspects of counter performance and cocktail performance.

Full Spectrum DPM - Advance spectrum analysis technique used to separate the individual radionuclide spectra in dual-label samples to calculate DPM results.

Lower Limit - Defines the lower energy level of a region or channel.

Optical Quenching - A reduction in the scintillation intensity seen by the photo-multiplier tubes due to absorption of the scintillation light by material present in solution or deposited on the walls of the sample container or optic. The result is fewer photons per kev of beta particle energy and usually a reduction in counting efficiency.

Photoluminescence - Delayed and persistent emission of single photons of light following activation by radiation such as ultraviolet.

Quench Indicating Parameter - A value indicating the level of quenching in a sample (may be SIE, SIS, SCR, ESR or TSIE).

Sigma, Percent - An expression of the standard deviation as a percentage. It is numerically equal to 100 times the Standard Deviation divided by the mean.

Single Label - Only one radionuclide in a sample.

Spectral Index of External Standard - A number obtained from the spectrum analyzer that is calculated from the spectral distribution of the external standard and is used as an index of the level of quenching in the sample.

Spectral Index of the Sample - A number obtained from the Spectralyzer spectrum analyzer that is calculated from the spectral distribution of the sample and is used as an index of the level of quenching in the sample.

Spectralyzer™ Spectrum Analyzer - The spectral-analytical section of the Packard Tri-Carb Liquid Scintillation Counter.

Spillover - A term used to describe the situation in dual-label counting where a portion of the spectrum from one radionuclide is included in the region used to count the other radionuclide.

Transformed Spectral Index of the External Standard - A number obtained from the Spectralyzer spectrum analyzer that is calculated from the spectral distribution of the external standard and is used as an index of the level of quenching in the sample.

2.0 FACTORS INFLUENCING OPERATION

2.1 Environmental Conditions

The instrument can be adversely affected by a range of environmental conditions and should be installed and used in a location which minimizes these affects. Once the instrument has been installed in an appropriate location, fluctuations in environmental conditions, within the ranges specified below, should not affect the machine's performance.

2.1.1 Temperature

The instrument should be located in a controlled environment having an ambient temperature range of 59°F to 95°F.

2.1.2 Humidity

The instrument should be located in a controlled environment having an ambient humidity range of 30% to 85%, noncondensing.

2.2 Background Radiation

The background radiation levels associated with both the instrument's environment and other background radiations associated with events taking place outside the sample itself will have an affect on the instruments performance. The following is a discussion of the means by which this affect is minimized.

2.2.1 Electronic Background Discrimination

The sensitivity of detecting radioactive events is limited by the presence of background radiation. To increase counting sensitivity, the ratio of count rate to background must be maximized. Recent advances in counter technology allow the discrimination of background radiation from sample activity. This new technique supplements coincidence counting and is based on Time-Resolved Spectrum Analysis. Time-Resolved spectrum analysis can be used to exclude some of the background pulses from the beta spectrum by using pulse index discrimination. This unique feature gives superior counting performance and low-level counting sensitivity. For more information see the Electronic Background Discrimination section of reference 9.1.

2.2.2 Environmental Background Radiation

Another phenomenon which influences all counting is the inevitable background produced by environmental radiation. Several sources of radiation can affect the sensitive scintillation solution and the detection process.

- Cosmic radiation which is variable and influenced by sun spot activity and barometric pressure.
- Fallout from nuclear tests which might be contained in the air.
- The building materials of the laboratory which contain activity.
- Natural activity in glass sample vials and the walls of the photomultiplier tubes.
- Stray radiation from sources of activity in the laboratory, or apparatus producing radiation such as x-rays or magnetic fields.

The sample in the counting chamber and the PMTs are surrounded by lead, typically about two inches (5 cm) in all directions. This lowers the background to reasonable proportions for all but very low activity measurements.

The instrument should optimally be installed away from all sources of radiation, including magnetic sources. It is permissible to store small check sources of low activity in the same room as the instrument so long as they are not stored immediately adjacent to the instrument. Such check sources do not refer to the LSC standards normally stored in the machine.

2.3 Sample Interferences and Considerations

2.3.1 Coincidence Circuitry

The coincidence requirement that each PMT produce a response sets a limit of detection. The beta particle must have sufficient energy to produce at least two photons and one must interact with each PMT. Inevitably, because the photons are radiated in all directions, some will be lost despite the reflector. Thus, the probability of a photon entering each PMT decreases with decreasing beta particle energy. Below a few keV of energy the yield of photons, under ideal conditions, is 7-8 photons per keV.

The photocathode of a PMT is not 100% efficient. The conversion efficiency from a photon to a photoelectron (the quantum efficiency) is only about 30%. Hence, when dealing with H-3, where the average beta energy is less than 6 keV, this radionuclide cannot be detected at 100% efficiency as many events do not produce a sufficient number of photons.

The net effect of these two factors creates a threshold of detection below which an event is unlikely to be recorded. This level is referred to as the coincidence threshold and in energy terms occurs below 1 keV.

2.3.2 Chemical Luminescence/Photoluminescence

Chemiluminescence is the production of light as a result of a chemical reaction. This most typically occurs in samples of alkaline pH and/or containing peroxides, when mixed with emulsifier-type scintillation cocktails.

Photoluminescence results in the excitation of the cocktail and/or vial by ultraviolet light. This can occur by exposure to sunlight or florescent lights used in the laboratory.

In terms of decay, there is a difference between chemiluminescence and photoluminescence in that chemiluminescence has a fairly slow decay time (from 0.5 hr. to more than a day dependent on temperature) while photoluminescence decays more rapidly (less than 0.1 hr.).

In terms of spectral analysis, there is no apparent difference between chemiluminescence and photoluminescence. Luminescence is a single photon event and is registered as a count due to the probability of having coincident events at high luminescent activity. The pulse height distribution depends only slightly on the intensity of the reaction. The spectrum has a pulse height distribution overlapping the H-3 spectrum.

The maximum pulse height corresponds to approximately 6 keV and the spectrum is (chemical) quench independent (as the events are not generated by converting beta particles to photons but by the reaction itself).

These characteristic properties of the luminescence spectrum make it easy to distinguish from a beta energy spectrum, using spectrum analysis. Delayed coincidence counting and spectral stripping techniques are applied to correct the results for luminescence influence.

2.3.3 Quenching

The counting efficiency of the solvent-solute system may be reduced by many different factors. These are briefly described below.

- Photon quenching - incomplete transfer of beta particle energy to solvent molecules;
- Chemical quenching (sometimes called impurity quenching) - causes energy losses in the transfer from solvent to solute;
- Optical quenching - causes the attenuation of photons produced in the solution.

The total effect is collectively referred to as "quenching" and the result is energy loss in the liquid scintillation solution. As a result, the energy spectrum detected from the radionuclide appears to shift toward lower energies.

From this change in energy distribution, it appears that the counting efficiency is dependent on the degree of quenching and thus on the nature of the sample, the scintillator used and the preparation method.

It is therefore essential to monitor the counting efficiency in each sample by comparisons with standards or other samples. In modern automatic scintillation counters, the counting efficiency is determined for each sample and the detected counts are converted to disintegrations to correct for quenching effects.

The application of high resolution spectrum analysis allows the calculation of two efficient and very accurate parameters to monitor quench levels.

The Spectral Index of the Sample (SIS) uses the sample spectrum to derive a quench index, while the Transformed Spectral Index of the External Standard Spectrum (tSIE) is calculated from the Compton spectrum, induced in the sample by the external standard source (133Ba).

Both parameters provide fast and accurate radionuclide efficiency values for virtually all types of liquid scintillation samples.

2.4 Equipment and Reagents

2.4.1 Vial Selection

Vial sizes and configurations are specified in reference 9.1. Vials of several sizes and construction materials are available for use. Vial selection should be made based on the requirements of the sample. For the analysis described in this procedure, 20 ml. plastic vials, supplied by the manufacturer of the instrument, or equivalent, should be used.

2.4.2 Scintillation Cocktail Selection

Determination of the scintillation solution to be used is based on several factors:

- The ability of the solvent to dissolve the sample into a homogeneous state
- The amount of sample which can be loaded into solution
- The efficiency of the solution to detect the analytes at the desired level of confidence
- The level of hazard associated with working with the solution
- Disposal considerations

These factors cannot generally be optimized in one solution and therefor should be carefully evaluated to determine the scintillation cocktail to be used for each analysis. In all cases, the generation of mixed waste should be avoided. For this reason the instrument custodian shall have ultimate control over the selection of scintillation cocktail.

For the analysis described in this procedure, several environmentally benign scintillation cocktails are available that are marketed as non-hazardous. Use of these cocktails will minimize the controls necessary for their use, storage and disposal while maintaining counting efficiencies comparable to other high efficiency cocktails. The instrument custodian will work in conjunction with operators of the machine to determine which scintillation cocktails are used and to determine the associated disposal requirements.

2.4.3 Sample Loading and Collection

The scintillation cocktails described in this procedure are capable of sample loadings in aqueous solutions of up to 50% water. Overloading of the scintillation cocktail with too much sample could adversely affect sample results. In all cases, sample loading should be consistent for a given sample type and is specified in section 5 for the scope of analysis associated with this procedure.

For analysis involving a wipe test, the ability of the sample media to collect the desired analyte will be a factor which will affect the results of those analysis. Removal efficiency has been considered in conjunction with the sample media's affects on sample quench and geometry. Whatman 1 filters have been chosen for use during wipe tests because the filter's quench and geometry effects are far outweighed by the filter's high removal efficiency when dampened with demineralized water.

2.5 User Specified Parameters

2.5.1 Count Time

Both the length of count and the number of counts per sample will affect the outcome of the analysis. A longer count time will result in a decrease in the Lower Limit of Detection (LLD), and subsequent Minimum Detectable Activity (MDA), achieved during the analysis. Increasing the number of counts associated with an individual sample will increase the level of confidence associated with that sample analysis.

Count times and the number of times to count each sample are specified in section 5 for those individual analysis.

2.5.2 Method of Quench Determination

The various methods of quench determination which can be used by the Packard LSC are described in section 2.3.3. For the scope of analysis described in section 5, the tSIE of the sample will be used to determine its corresponding level of quench. This method provides the most accurate method of quench determination available with this instrument.

Once the tSIE of the individual sample is determined, the instrument will compare it to the quench curves supplied by the manufacturer to determine the level of quench associated with the sample.

If required by a particular analysis, the instrument custodian, in conjunction with the persons performing that analysis, may specify additional quench curves to be used during this determination. Additional quench curves may be obtained through the use of quenched standards available from the manufacturer of the instrument or may be produced locally.

2.5.3 Method of DPM Determination

Determination of a specific activity corresponding to counts obtained in a specified region can be done in various ways. This factor will have a significant impact on the outcome of individual analysis. The method chosen to perform this determination is specified in section 5 for the individual analysis described in this procedure.

For the specified analysis, the dpm option chosen is dual DPM. This method was chosen based on the nuclides used at LEHR and the instrument's ability to quantify those isotopes. Since both H-3 and C-14 were used, use of the dual DPM option provides the highest level of accuracy for determination of the sample activity. The dual dpm option optimizes the instrument's capability to identify separate peaks observed in overlapping regions of the energy spectrum. This overlapping of energy ranges is referred to as spillover.

3.0 OPERATION

3.1 Equipment

The following equipment will be required for the performance of the analysis described in this procedure. Additional equipment may be required if additional analysis are to be performed.

3.1.1 Liquid Scintillation Counter

This procedure has been written for use of the Packard Tri-Carb[7] Liquid Scintillation Counter. If another type of LSC is to be used, this procedure should be changed to reflect the equipment used.

Prior to use, the LSC shall be installed by qualified personnel in accordance with the manufacturers instructions and in a location described in sections 2.1 and 2.2. The performance of the instrument shall be evaluated by performing a baseline IPA. This baseline consists of the initial 5 data sets from which the limits for the 8 parameters evaluated during the IPA will be obtained. The procedure for performance of an IPA is described in section 4.2 of this procedure.

3.1.2 Standards

Unquenched standards for both C-14 and H-3 as well as a manufacturer supplied background sample will be necessary for the performance of the SNC and IPA.

A series of quenched standards for H-3 or C-14 is no longer necessary for the performance of quantitative analysis. The manufacturer of the instrument has installed a set of quench curves into the instrument's memory for the isotopes and scintillant specified in this procedure. In the event that additional scintillation cocktails are used or different analysis are performed, the use of these quench curves to quantify results should be evaluated.

3.1.3 Vials

The vials to be used in the performance of these analysis are 20 ml. plastic vials. These vials are readily available from the manufacturer as well as various scientific equipment suppliers. Additional information concerning the affects of various vail sizes and types may be found in section 2.4 of this procedure and in reference 9.1.

3.1.4 Reagents

The LSC process requires that the sample be placed in a container with scintillation solution. In this combination the scintillation solution (cocktail) is the solvent and the sample is the solute.

The scintillation cocktail recommended for use in the performance of the analysis described in this procedure is Packard's Ultima-Gold scintillation cocktail. This scintillation solution is marketed as non-hazardous and should be easily disposed of after use. Scintillation solutions classified as hazardous should not be used without the concurrence of the instrument custodian and the LEHR RCM.

3.1.5 Sample Media

For surface activity measurements, a media which is wiped over the surface being assayed is needed. This media is typically a filter paper or similar material. For the analysis described in this procedure, a Whatman 1 filter paper should be used where required.

3.2 Conversation

Conversation allows the instrument operator to define new protocols, edit or copy existing protocols, enter active counting conversations, or group PrioStat conversations, spectrum display, etc. All program interaction is performed via the keyboard and does not interrupt automatic operation of the system. All conversation is displayed as a series of related questions and answers. The following is a description of the most common pages displayed during conversation.

3.2.1 Status Page

The **Status Page** gives a visual representation of what the instrument is currently doing and the status of all protocols. This page also gives access to all other conversation pages. The **Status Page** displays system messages (such as Counting Protocol 16 or Idle) at the top of the screen along with the date and time.

The screen displays the information for the sample being counted as well as a description of listed protocols and their assigned names. Protocols being counted are tagged as (A)-active, protocols whose cycles are complete are tagged (C)-complete, and protocols being used by Group PrioStat are tagged (P)-Group PrioStat.

The function keys are defined at the bottom of the screen. All other screens are accessed from the **Status Page** through the use of these function keys.

3.2.2 Edit Protocol Page

The **Edit Protocol Page** is selected using the function keys from the **Status Page**. The **Edit Protocol Page** displays all the defined protocols and their names. The program allows the user to edit any of the 30 available protocols. Once a protocol has been selected for editing, the **CPM Page** is displayed.

3.2.3 CPM Page

The **CPM Page** allows the user to edit various portions of the selected protocol. When the cursor is moved to a question, the possible responses are listed on the help line just above the function keys. The function keys change definition with each question. If the question requires a numeric or alpha response the keyboard is used. If the range of options is small, the function keys are used.

A table listing each question along with a brief description of what the question is asking can be found in Chapter 5 of reference 9.1. The table also gives a range of responses and the default value assigned to the system.

3.2.4 DPM Page

The **DPM Page** of conversation is displayed as a function of the response to the "Data Mode?" question on the **CPM Page**. This page of conversation allows the user to select how the quenched standards data are to be entered into the system. For the scope of operations defined in this procedure, "Use Curve" should be selected unless otherwise directed by the instrument custodian or if specified in another procedure directing the use of the instrument.

3.2.5 Additional Features Page

The **Additional Features Page** allows the user to select installed options to be applied to the selected protocol including the option of saving the sample data and/or spectrum to disk.

A table listing each question along with a brief description of what the question is asking can be found in Chapter 5 of reference 9.1. The table also gives a range of responses and the default value assigned to the system.

3.2.6 Print Format Page

The **Print Format Page** allows the user to define the format for the printout of sample results. In this page of conversation, the user may define the printout to contain as much or little information as desired. Each item that may be printed are referred to as a cell. The "Flags" field should always be included to ensure the user is alerted to any flags which are tripped during the counting of a sample set using the assigned protocol.

A table listing each question along with a brief description of what the question is asking can be found in Chapter 5 of reference 9.1. The table also gives a range of responses and the default value assigned to the system.

3.2.7 Sample Changer Control

The **Sample Changer Control Page** is accessed from the **Status Page** and is used to gain manual control over the sample changer. There are four options available to the user once this page of conversation is entered.

Forward - The sample changer will move continuously in the forward direction. In this mode, the system will bypass all samples and protocol plugs until another function is selected.

Reverse - The sample changer will move continuously in the reverse direction. In this mode, the system will bypass all samples and protocol plugs until another function is selected.

Next Sample - The sample being counted will be unloaded and the sample changer will advance to the next available sample in line.

Stop - This function causes the sample changer into an idle condition until another function key is depressed.

3.2.8 Spectrum Page

The **Spectrum Page** is accessible from the **Status Page** and will generate a live spectrum display for each sample counted. The only available question in this page of conversation is the full scale value of the keV axis. The spectrum display can be used for routine observations of counting conditions.

3.2.9 IPA Page

The **IPA Page** is accessed from the **Protocol Page** and allows setup and assessment of IPA functions. The assay values and corresponding dates for the unquenched standards are entered into memory in the **IPA Page** of conversation. These values should not be changed without the concurrence of the instrument custodian. The values for H-3 E^2/B and C-14 E^2/B Threshold, determined during the performance of the baseline IPA, have been entered here and should not need to be changed.

From the **IPA Page**, the user can review the data from any of the eight parameters monitored during the performance of the IPA. This data can be viewed and/or printed in tabular or chart format.

3.3 Precautions

The following precautions are to be observed during the performance of all activities associated with this procedure.

3.3.1 Radiological Controls

Since the analysis described in this procedure are being performed to determine the level of radioactive content in a sample media, the standard radiological control practices specified in reference 9.4 shall be used to control worker exposures and the potential spread of radioactive contamination during sampling operations.

3.3.2 Hazardous Material Controls

This procedure currently recommends the use of an environmentally benign cocktail for use in sample preparation. This chemical still retains properties which need to be considered when it is handled. A current MSDS for the cocktail(s) used shall be kept readily accessible in the vicinity of the sample preparation area. Personnel who prepare samples for analysis or otherwise come in contact with the scintillation cocktail should become familiar with the MSDS for those cocktail(s) prior to handling. To prevent dermal contact with the cocktail, nitrile gloves shall be worn by all personnel when preparing samples for analysis.

In the event that the use of additional reagent chemicals is added to this procedure, the approved Health and Safety Plan(s) associated with the individual personnel operating the instrument shall be utilized to control the use, handling and storage of those material(s).

3.4 Prerequisites

3.4.1 Instrument Setup

Prior to use, the instrument shall be installed by qualified personnel in accordance with the manufacturers instructions. A baseline IPA shall have been performed in accordance with section 4.2 of this procedure.

3.4.2 Establish Protocols

Protocols shall be defined for use during the analysis described in section 5. These protocols specify how the instrument controls the counting of individual sample sets and defines parameters to be applied to that sample's analysis. The parameters to be included in the protocols associated with the individual analysis described in this procedure are described in section 5.

The basic procedure for entering into conversation with the instrument and defining a protocol is described in section 3.2.

3.5 Sample Preparation

Samples shall be obtained in accordance with the requirements of the procedures which direct them to be taken. In all cases the considerations described in section 2.4 of this procedure should be followed when preparing samples for analysis.

Samples shall be prepared in an area and in a manner which minimizes the chance of cross contamination of samples and surfaces. Radiological controls procedures to be followed when handling potentially radioactive materials are specified in reference 9.4.

Adequate time shall be allowed prior to counting samples in order to minimize the effects of luminescence in the sample. Operating experience at the LEHR site indicates that approximately 4 hours of time should be allowed to eliminate these affects. Chemical and photoluminescence is described in section 2.3.2 of this procedure.

3.6 Sample Counting

Once prepared, samples shall be placed in sample cassette(s), for loading in the instrument. For the scope of analysis currently included in this procedure, first vial background samples shall be placed in the first sample slot in the cassette. Background vials for wipe samples should be a dampened filter paper placed in a sample vial with the same mixture of scintillant/water as the sample that will be analyzed.

Insert the appropriate protocol plug in the cassette and move the flag to the left, thus identifying to the instrument which protocol is to be applied during the sample analysis.

Enter into conversation with the instrument and from the status page, start the sample count by pressing F2. Once all the samples loaded into the instrument have been counted and analyzed, the instrument will place itself into an idle condition until directed to perform additional analysis.

4.0 PERFORMANCE VERIFICATION

4.1 Self-normalization and Calibration

Self-normalization and calibration (SNC) adjusts each photomultiplier tube (PMT) to balance its response to sample activity and calibrates the spectrum analyzer in keV. The instrument utilizes the unquenched C-14 source to sequentially adjust the high voltage applied to each PMT to be half of the normal SIS of that standard. The instrument will then apply voltage to both PMTs, test the SIS and adjust each PMT until tSIE is 1000.

The LSC will automatically perform an SNC count every 23 hours. The following describes the necessary steps to manually perform a self-normalization and calibration:

4.1.1 Insert the SNC protocol plug into the SNC cassette. Load the unquenched C-14 standard into position number one of the cassette and load the cassette into the sample changer.

4.1.2 The instrument will now perform an SNC count the next time the SNC cassette is recognized and every 23 hours thereafter. To initiate the count manually, set the cycle flag on the SNC cassette to the left and initiate the count by pressing the F2 key from the status page.

For the purposes of this procedure, the SNC cassette will be further utilized in the IPA procedure described in section 4.2.

4.2 Instrument Performance Assessment (IPA)

The IPA and Auto QA features of the LSC use the system's SNC capability to monitor the background, efficiency, Figure of Merit (E^2/B), and Chi-squared values for both the H-3 and C-14 regions.

4.2.1 System Functions and Configuration

Three separate samples are used for the IPA procedure and are placed in the SNC cassette in the following order:

- Position 1 - C-14 Unquenched Standard
- Position 2 - H-3 Unquenched Standard
- Position 3 - Background Standard

The C-14 unquenched standard is used to initially calibrate the system to obtain optimal performance by adjusting the voltage applied to the PMT's as described in section 4.1 (SNC portion of IPA). The

C-14 sample is then counted for one minute using regions of 0-156 keV for efficiency determination and 4-156 keV for E^2/B determination. The standard is then counted 20 times for 0.5 minute each in order to determine the Chi-square of the instrument using the 74-156 keV region for C-14.

The H-3 unquenched standard is counted for one minute to determine the H-3 efficiency in the 0-18.6 keV region and the E^2/B performance for H-3 in the 1-18.6 keV region is calculated. The Chi-square for H-3 is then determined for 20 counts of 0.5 minutes each using a region of 0-18.6 keV.

The background standard is then counted for 60 minutes in the following regions:

- 0-18.6 keV for H-3 background determination
- 0-156 keV for C-14 background determination
- 1-18.6 keV for H-3 E_2/B determination
- 4-156 keV for C-14 E_2/B determination

4.2.2 IPA Setup and Conversation

The IPA setup and assessment can be accessed from the Main Protocol Page by pressing the F10-etc function key followed by the IPA function key. The following steps should be completed prior to performing an IPA:

- The assay values and dates for the unquenched H-3 and C-14 sources shall have been entered into memory in order for the system to determine the exact DPM of the standards. These values need not be changed unless different standards are to be used.
- Set the IPA configuration to automatically determine the Chi-square for H-3 and C-14.
- Determine the C-14 and H-3 E^2/B thresholds in accordance with the procedure specified in reference 9.1 and enter the values here. Once set, these values should not need to be changed.

4.2.3 IPA Performance Assessment

In order for the system to automatically perform an IPA every 23 hours, the SNC cassette and the standards shall be left in the sample changer during normal operations.

The system uses the results of the IPA to monitor the performance of the instrument by establishing certain criteria for each of the eight IPA parameters. If any of these limits are exceeded, an error message is printed. In the event that an error message is received, the performance of the system shall be evaluated by qualified personnel prior to the system being used for quantitative analysis.

The system retains the results of each IPA performed in memory and tracks them in both a tabular and chart format. These results shall be retained as specified in section 6.1 of this procedure.

4.3 Level of QA

Analytical options available to support data collection activities are typically presented in five general categories. Of these, only three will apply to analysis associated with using the LSC. These are described below.

4.3.1 Level II - Field Analysis

This level is typically characterized by the use of portable analytical instruments which can be used in field laboratories. Depending upon the types of contaminants, sample matrix, and personnel skills, both qualitative and quantitative data can be obtained. This level of quality will be applicable to most analysis performed using the LEHR Site LSC.

4.3.2 Level III - Laboratory Analysis (Other)

This level of quality is applicable to analysis using standard EPA approved procedures. Analysis applying this level of quality may be performed with the LEHR Site LSC providing the appropriate procedures and protocols are followed by the user of the instrument.

4.3.3 LEVEL IV - Contract Laboratories Services

In the event that the procedures directing the performance of the samples described in this procedure require, additional outside validation of duplicate samples may be analyzed to this level of quality.

5.0 SCOPE OF USE

This document describes the procedures to be followed when utilizing the LSC for specific analysis. This section will delineate those specific analysis and direct the operator how to utilize this procedure to perform those analysis and obtain results at the desired level of confidence.

5.1 Screening Analysis of Smears for Low-Level Beta Emitters

This section will describe the procedures to be followed during the performance of the above named analysis.

5.1.1 Define a protocol to be used in the performance of this analysis. Procedures for defining a protocol are contained in section 3.4.2 of this procedure as well as in reference 9.1. The parameters listed below should be included in the protocol chosen. Parameters which have been changed from the default value are printed in italics. For parameters not specified below, use the system default values:

DPM Page

- 1 minute count time
- 1 count per vial
- 1 vial per standard
- 1 vial per sample
- First vial bkgd - *Yes*
- Radionuclide - *Manual*

- Enter the following energies for regions A, B, & C

  Region A: *0.0 to 12.0 kev*

  Region B: *12.0 to 156.0 kev*

  Region C: *156 to 2000 kev*

- 2 Sigma % - 0
- LCR - 0
- QIP - *tSIE/AEC*
- ES Terminator - Count
- % Reference - No
- Data Mode - *dual DPM*

DPM Page

- Standards Data - *Use Curve*
- Constant Quench - No
- Replot - No
- Edit Stds? - 0

Additional Features Page

- Single Photon Count - No
- Colored Samples - No
- RS-232 Output - No
- Heterogeneity Monitor - No
- Luminescence Corr. - No
- Data - *See note below*

NOTE: INFORMATION CONCERNING SAVING SAMPLE DATA AND SPECTRUMS IS CONTAINED IN SECTION 6.2.

5.1.2 Ensure the LSC is setup and operating as described in section 3.1 and that an SNC has been performed within the past 23 hours. Review the SNC/IPA data to ensure that the instrument is operating within specification and in accordance with additional requirements specified in procedures directing the use of the instrument. SNC and IPA performance are discussed in section 4 of this procedure.

5.1.3 Verify printer is online and has sufficient paper.

5.1.4 Wipe samples should be obtained by lightly dampening them with demineralized water and wiping the dampened media over the surface to be assayed. The media should immediately be placed in the sample vial containing a mixture of 10 ml. demineralized water and 10 ml. of scintillation cocktail. Sample preparation is further described in section 3.5 of this procedure.

5.1.5 Place samples in cassette and begin counting as specified in section 3.6.

5.1.6 Sample results will download to printer at the completion of each count. Copies of sample results should be retained as directed in section 8.

5.2 Analysis of Smears for Low-Level Beta Emitters During License Termination Surveys

This section will describe the procedures to be followed during the performance of the above named analysis.

5.2.1 Define a protocol to be used in the performance of this analysis. Procedures for defining a protocol are contained in section 3.4.2 of this procedure as well as in reference 9.1. The parameters listed below should be included in the protocol chosen. For parameters not specified below, use the system default values:

DPM Page

- 1 minute count time
- 4 counts per vial
- 1 vial per standard
- 1 vial per sample
- Yes - *First vial bkgd*
- Radionuclide - *Manual*

- Enter the following energies for regions A, B, & C
  Region A: *0.0 to 12.0 keV*
  Region B: *12.0 to 156.0 keV*
  Region C: *156 to 2000 keV*

- 2 Sigma % - 0
- LCR - 0
- QIP - *tSIE/AEC*
- ES Terminator - Count
- % Reference - No
- Data Mode - *dual DPM*

DPM Page

- Standards Data - *Use Curve*
- Constant Quench - No
- Replot - No
- Edit Stds? - No

Additional Features Page

- Single Photon Count - No
- Colored Samples - No
- RS-232 Output - No
- Heterogeneity Monitor - No
- Luminescence Corr. - No
- Data - *See note below*

NOTE: INFORMATION CONCERNING SAVING SAMPLE DATA AND SPECTRUMS IS CONTAINED IN SECTION 6.2. SAMPLE DATA AND SPECTRUM SHOULD BE SAVED WHEN PERFORMING SURVEYS IN ACCORDANCE WITH REFERENCE 9.2.

5.2.2 Ensure the LSC is setup and operating as described in section 3.1 and that an SNC has been performed within the past 23 hours. Review the SNC/IPA data to ensure that the instrument is operating within specification and in accordance with additional requirements specified in procedures directing the use of the instrument. SNC and IPA performance are discussed in section 4 of this procedure.

5.2.3 Verify printer is online and has sufficient paper.

5.2.4 Wipe samples should be obtained by dampening them with demineralized water and wiping the dampened media over the surface to be assayed. The media should immediately be placed in the sample vial containing a mixture of 10 ml. demineralized water and 10 ml. of scintillation cocktail. Wipe samples should be taken in quantity and at locations as specified in reference 9.2 to achieve desired data quality objectives. Sample preparation is further described in section 3.5 of this procedure.

5.2.5 Place samples in cassette and begin counting as specified in section 3.6.

5.2.6 Sample results will download to printer at the completion of each count. Copies of sample results should be retained as directed in section 8.

6.0 DATA STORAGE

Since the Packard LSC is a computer processor based instrument, information associated with both data quality and individual sample data may be stored on both electronic and physical media.

6.1 Printing and Storage of QA Data

QA data associated with the systems performance can be accessed through the **IPA Setup** conversation page. The results of individual IPAs are stored in the system's memory for a period of 2 months. The resultant information from each of the eight parameters monitored during the IPA shall be printed on a monthly basis and retained in a binder by the instrument's custodian for future reference. To print the IPA data, highlight "IPA Operation?" and choose the appropriate function key listed at the base of the **IPA Page** to print the tables.

6.2 Printing and Storage of Sample Data

Results of sample analysis will be printed automatically by the instrument as the samples are analyzed using the external printer.

Data associated with a specific sample analysis may be retained for future use by copying it to disk with the external disk drive. This shall be performed when required by the procedures initially directing the samples to be obtained.

Directing sample data and spectrum to be saved is performed from within the **Additional Features Page** of conversation for the selected Protocol. The options available to the user include saving to the floppy disk or the hard disk. Both the sample data and spectrum may be saved in either a short or long format. Care should be taken to not run out of disk space when saving sample data and spectrums to the system's hard drive.

The user specifies the path and drive in standard DOS format as well as the file name and extension. If a numerical extension is chosen, each subsequent sample saved will be incremented by the program.

Step by step procedures for saving sample data and spectrums to disk are contained in chapter 5 of reference 9.1.

7.0 CONTROL OF SAMPLES AFTER USE

In order to properly minimize the production of hazardous and radioactive wastes, any samples identified during analysis as being contaminated shall be handled and segregated as described below.

7.1 Responsibilities

- The instrument custodian is responsible for control and disposal of samples and sample containers.
- Personnel operating the instrument are responsible for controlling their samples after use in accordance with the requirements of this procedure.

7.2 Sample Controls

Samples which are identified during analysis as containing radioactive materials in excess of site limits shall be placed in the location designated by the instrument custodian for contaminated samples. In order to track the cumulative activity of the samples requiring disposal, the sample shall be marked indicating it's identity and contents, and a copy of the sample results shall be placed in the storage location along with the sample. These samples shall be handled and disposed of in accordance with the requirements specified in reference 9.3.

Samples which are identified during analysis as not containing radioactive materials shall be placed in the location designated by the instrument custodian for non contaminated samples. These samples shall be disposed of by the instrument custodian in accordance with UCD procedures.

The instrument custodian shall initiate appropriate steps to ensure that samples are properly segregated, handled, stored and disposed of. This may include:

- Posting written instructions in the vicinity of the instrument identifying storage locations and associated requirements.
- Performing periodic recounts of samples from both the contaminated and non-contaminated storage locations to verify analytical data.

- Monitoring the use of the instrument by site personnel.

8.0 RECORDS

Records generated as the result of operations associated with this procedure shall be retained in accordance with the following requirements:

- Results of SNC and IPA data shall be retained by the instrument custodian in a binder located in the vicinity of the instrument. The last year's data shall be retained in this manner. Previous year's data shall be retained in accordance with UCD records procedures. Copies of this quality related data shall be made available to personnel using the instrument for inclusion in contractor project records.
- Results of sample analysis shall be retained in accordance with the requirements of the procedure(s) requiring the use of the instrument.

9.0 REFERENCES

9.1 *Packard, "Tri-Carb Liquid Scintillation Analyzer Operation Manual, Model 2100TR/2300TR", 1994*

9.2 *U.S. NRC, "NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination", June 1992*

9.3 *Weiss Associates/LEHR, "Waste Management Annual Report for Fiscal Year (FY) 1997 and Waste Management Plan",*

9.4 *D.O.E./LEHR, "LEHR Radiological Control Manual", July 1993*

CHECK-IN AND ORIENTATION FOR RADIOLOGICAL WORKERS, GENERAL EMPLOYEES OR MEMBERS OF THE PUBLIC

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes the check-in and orientation requirements for anyone entering to the Laboratory for Energy-related Health Research Environmental Restoration (LEHR ER) Project Site for any purpose related to the site restoration and defines the requirements for documentation and implementation of check-in and orientation procedures. Issuance of dosimetry will be in accordance with SOP 38.2, External Dosimetry Issuance (Reference 2.3).

2.0 REFERENCES

2.1 *10 CFR 835 Occupational Radiation Protection; Final Rule, November 1998. Department of Energy*

2.2 *29 CFR 1910.120 Hazardous Waste Operations and Emergency Response; Final Rule*

2.3 ***SOP 38.2, External Dosimetry Issuance***

2.4 *SOP 38.3, Radiation Protection Records*

3.0 DEFINITIONS

3.1 ALARA

"As Low As is Reasonably Achievable" (ALARA) is the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. As used in this part, ALARA is not a dose limit but a process which has the objective of attaining doses as far below the applicable limits of this 10 CFR 835 (Reference 2.1) as is reasonably achievable

3.2 Contractor

Any entity under contract with the Department of Energy (DOE) with the responsibility to perform activities at a DOE site or facility

3.3 Controlled Area

An area to which access is controlled by or for DOE to protect individuals from exposure to radiation and/or radioactive materials

3.4 DOE

Department of Energy

3.5 GERT

General Employee Radiation Training

3.6 General Employee

General Employee (GE) is an individual who is either a DOE or DOE Contractor employee; an employee of a subcontractor to a DOE contractor; or an individual who performs work for in conjunction with DOE or utilizes DOE facilities

3.7 ITEH

Institute for Toxicology and Environmental Health

3.8 LEHR

Laboratory for Environmental Health and Restoration, (LEHR) Project Office (LPO): two trailers (Health and Safety-brown trailer; Administrative-silver trailer) located on the north side (ITEH).

3.9 Member of the Public

Member of the Public is a visitor who is not occupationally exposed to radiation or radioactive material. An individual is not a "member of the public" during any period in which the individual receives an occupational dose.

3.10 Prime Contractor

Contractor to whom DOE has awarded the prime contract for managing the environmental restoration project at the LEHR Site.

3.11 Radiation Safety Training

Radiation safety training shall include the following topics, to the extent appropriate to each individual's prior training, work assignments, and degree of exposure to potential radiological hazards:

- Risks of exposure to radiation and radioactive materials, including prenatal radiation exposure:
- Basic radiological fundamentals and radiation protection concepts;
- Physical design features, administrative controls, limits, policies, procedures, alarms, and other measures implemented at the facility to manage doses and maintain doses ALARA, including both routine and emergency actions;
- Individual right and responsibilities as related to implementation of the facility radiation protection program;
- Individual responsibilities for implementing ALARA measures; and,
- Individual exposure reports that may be requested in accordance with 10 CFR 835 (Reference 2.1).

4.0 RESPONSIBILITIES

4.1 Project Manager (PM)

The Project Manager (PM) is responsible for the safe and effective implementation of this procedure.

4.2 Site Health and Safety Officer (SHSO)

The Site Health and Safety Officer (SHSO) is responsible for the initial issuance of dosimetry and for the continued normal change out of those dosimeters. The SHSO is responsible for maintaining a supply of dosimeters for issuance to other project personnel (subcontractors) working at the LEHR Site, and for the collection of those dosimeters when these personnel leave the site. The SHSO acts in the capacity of a Dosimetry Program Manager and ensures that applicable LEHR personnel follow the procedures that have been developed for external dosimetry issuance, dosimetry use, data interpretation and records control. The SHSO will also check on training styles of hazardous waste workers (Reference 2.2).

5.0 GENERAL CHECK-IN INFORMATION

All persons entering the LEHR site for purposes related to DOE site restoration activities should report to the Health and Safety LEHR Project Office (HSLPO) or their regular on-site contractor supervisor for check-in and orientation. Contractors and other on-site staff/general employee who will be working regularly at the LEHR Site shall report to their supervisor on their initial visit, and may not begin work until they have completed required processing and paperwork. On-site contractors will check-in and provide orientation for their sub-contractors, their General Employees, their visitors, General Employees to their subcontractors, and visitors to their sub-contractors. ITEH Staff and ITEH members of the public are not involved with site remediation work and, as such, do not come under the provisions of this procedure, except when entering areas where DOE environmental restoration project work is in progress.

The SHSO, RSO, or RCM may withhold site access to any individual.

6.0 MEMBERS OF THE PUBLIC CHECK-IN

Members of the public (visitors) shall report to the Health and Safety LEHR Project Office or to the controlling contractor office on each visit to the site. LEHR site visitors shall have a contact person who is aware of their intended visit and who knows the nature of the visit. If the contact person is aware of the visit in advance, then the contact person is responsible for informing the prime contractor through the SHSO or other designated individual.

6.1 Members of the Public Log

All visitors shall sign in and out each day on the LEHR Visitor Sign-In Log (Attachment 10.1) or on the subcontractor's office log. A Visitor Orientation Sheet captures information identifying the reason for the visit and the site contact person. The prime contractor is responsible for assuring that appropriate site-related training and personnel safety requirements are met. In the event of a site emergency or evacuation, the LEHR Visitor Sign-In Log should be reviewed to assure everyone on-site has been safely accounted for. Visitors who are on-site *solely* for the purpose of attending a meeting held in an administrative area do not need to sign the Visitor Check-In Log if the meeting includes an attendance list, which will be included in project records.

A single page of the log may be used for the day, week, or month, depending on the number of members of the public signing in. The numbering system for the log shall be monthly--if four pages are used during the month they will be numbered from 1 of 4 to 4 of 4. At the end of the month, all site visitor logs will be filed in the LEHR Visitor Sign-In Folder located in SHSO office.

6.2 Members of the Public Orientation

Members of the public visitors visiting the LEHR Site shall read and sign the Visitor Orientation Form (Attachment 10.2) or an equivalent form prepared by the hosting prime contractor. The Members of the Public Orientation Sheet is completed only on the initial visit; any changes will be updated after the initial visit.

Visitors will not enter radiological controlled areas. Visitors will be given written and verbal radiation safety training (see Section 3.1) if they are to enter controlled areas unescorted.

7.0 GENERAL EMPLOYEE WORKER CHECK-IN

General Employees shall report to their assigned controlling contractor supervisor for orientation, site-specific training, completion of required employment documents, and evaluation of additional training needs required to begin work. In addition, the law requires workers assigned more than 30 working days a year at a waste site to be in a medical surveillance program. Results of record evaluation and training documentation shall be provided to the prime contractor before the employee begins work. If external dosimetry is required, see Section 8.0.

7.1 General Employee Orientation

Contractors shall provide training and orientation as appropriate for the tasks the general employee will be expected to perform. For workers whose assignments involve site remediation of radiological and/or hazardous waste, training shall include 29 CFR 1910.120 HAZWOPER (Reference 2.2) training requirements and DOE Radiological Worker training. This training shall be completed prior to any assignment involving hazardous waste operations. In addition, all general employees shall receive site emergency training in accordance with the site Contingency Plan and General Emergency Response Procedures.

General employees who may routinely encounter radiological barriers and postings shall receive General Employee Radiological Training (GERT). General Employee Radiological Training shall include the standardized core course training materials, including site-specific information, such as site-specific radiation types, alarm responses and policies. The expected time to complete the standardized core and site-specific GERT is approximately 2 hours and may be communicated by classroom lecture, videotape, or other applicable methods, such as the computer module that are available on-site. Applicable information pertaining to GERT training shall be included on the "GERT Log" (Attachment 10.3).

Training beyond GERT is necessary for unescorted entry into Radiological Buffer Areas or areas posted for radiological control. Additional information on this training is provided in HSP 20.1, Employee Subcontractor Training Requirements.

8.0 RADIOLOGICAL WORKER CHECK-IN

The information within this section is required for radiological worker check-in.

The SHSO will issue dosimetry to site workers and general employees who enter radiological controlled areas.

8.1.1 A completed copy of a Personal/Occupational History sheet (Attachment 10.4) will be filed in each individual's training file. The personal history includes full name, unique identification number, date of birth, current home address/phone number, current employer/address/phone number, and radiation exposure history if any. A Training Certificate List identifying training requirements is also filed in the Individuals Training Folder (Attachment 10.6).

8.1.2 A radiation history request letter signed by the company and/or general employee stating the employee's lifetime occupational radiation exposure and annual "to-date" occupation radiation exposure. This is required when an employee has had previous occupational exposure (a 'zero'-exposure is considered a reportable exposure). The radiation history information should be equivalent to requirements defined with 10 CFR 835.702, Individual Monitoring Records and as stated in SOP 38.3 (Reference 2.4), Individual Monitoring Records. Request for Report of Radiation History (Attachment 10.5) will be filled out and signed by the individual, reviewed and initialed by the SHSO.

8.2 External Dosimetry Issuance

See SOP 38.2, External Dosimetry Issuance (Reference 2.3)

9.0 [SECTION RESERVED FOR FUTURE USE]

10.0 ATTACHMENTS

10.1 *LEHR Visitor Sign-In Log*

10.2 *Visitor Orientation Form*

10.3 *General Employee Radiation Training Log (GERT)*

10.4 *Personal/Occupational History*

10.5 *Request for Report of Radiation History*

10.6 *Training Certificate List*

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 10.1

LEHR VISITOR SIGN-IN LOG

LEHR VISITOR SIGN-IN LOG

MONTH ______________ YEAR ______________

DATE					NAME	COMPANY	PHONE	CONTACT	REASON FOR VISIT
MO/DAY/YR			TIME IN	TIME OUT					

ATTACHMENT 10.2

VISITOR ORIENTATION FORM

VISITOR ORIENTATION FORM

Escort and/or Contact Person: ______________________________

Name:	
Home Address:	
Identification # and type:	
Date of Birth:	
Reason for Site Visit:	
Employer:	
Work Phone:	
Company Address:	

Please Read and Sign Below

Members of the Public must go through a site-specific orientation according to The Radiation Protection Program (10 CFR 835). The following information is one of the tools to satisfy this requirement:

- Radiological and/or Chemical hazards are not present in areas where tours, group walks or meetings are held.

- Strontium 90, radium 226, and cesium 137, and tritium are the main radionuclides identified in the soil. Tritium is also identified in the ground water. Members of the Public will not be permitted in areas under investigation and/or remediation, or in storage areas for radiation waste. These areas will be posted, and roped, chained, or taped off with clearly marked sign(s). The following signs are examples radiation warnings with the standard radiation symbol of yellow background and magenta or black logo:

RADIOACTIVE MIXED WASTE **RADIOACTIVE MATERIALS**

- Specific training is required to go beyond the posted boundaries.

- Types of LEHR site potential emergency conditions include fire, earthquake, hazardous or radioactive chemical spills, and heavy equipment failure. In the event of an emergency, an emergency signal horn (an air horn or car horn) will be used to alert LEHR. One long blast from the emergency signal horn requires all staff to report immediately to the **northwest corner parking lot**, or to another location designated by your escort or health and safety personnel.

- Radiological Exposure Limits for members of the public, as stated in the 10 CFR 835, is 0.10 Rem (or 100 mRem) per year (a year measured by 2080 hours). The LEHR administrative level limit for members of the public is 0.08 (or 80 mRem) per year. REM, Radiation Equivalent Man, is a unit for measuring dose equivalence. A dose is the quantity of radiation absorbed over a period of time. Measuring dose equivalence considers the energy absorbed (dose) and the biological effect on the body. A person flying 2084 hours (1 year) in an airplane would receive a dose of 1040 mRem. Compare 100 mRem per year to 1040 mRem per year. As you can see both 10 CFR 835 and LEHR administrative control limits are conservative.

- Photography of the site or of site work must be cleared with the Project Manager.

I have read and understood the above information:**______________________________*****Date:*****__________**

ATTACHMENT 10.3

GENERAL EMPLOYEE RADIATION TRAINING LOG (GERT)

General Employee Radiation Training Log (GERT)

1. Basics of Radiation
2. Risks in Perspectives
3. ALARA Responsibilities
4. Radiological Control

Print Name	Company	Identification No.	Signature	Date of Training	P/F

(When page is full or at end of the calendar year, place this roster in project training files)

j:\doe\4000\d3\sq&ops\wasops\sopforms\sop38_1c.doc

ATTACHMENT 10.4

PERSONAL/OCCUPATIONAL HISTORY

PERSONAL/OCCUPATIONAL HISTORY

Full Name	Parent Company/Co. Phone:
Home Street Address:	Department:
City/State/Zip:	Supervisor:
Home Phone:	Company Address:
Social Security: #	City/State/Zip:
Birth Date:	If Sub-Contracted, Name of Sub-Contractor:

Start Date: __________ Previously at LEHR? _____ If Yes, Specify Date(s): ______________________________

Previous External Radiation History (if you have no previous history, write NONE): ___________________

Company Name: ______________________________

Company Address: ______________________________

Dates Employed: ______________________________

Company Name: ______________________________

Company Address: ______________________________

Dates Employed: ______________________________

Lifetime: ________________ Current Year: ________________ Current Quarter: ________________

Previous Internal Radiation History: Yes: _____ No: _____

If Yes, Specify: ______________________________

Previous doses from therapeutic and diagnostic medical radiation, or participated as a subject in medical research programs: Yes: _____ No: _____
If Yes, Specify: ______________________________

I acknowledge that copies of this form and signature are valid.

____

Signature Authorization **Date**

For Office Use Only SHSO initial after each TLD issuance

TLD # ___________ Grp. # _____ Badge date ___________ Issue date ___________ Return date ___________

TLD # ___________ Grp. # _____ Badge date ___________ Issue date ___________ Return date ___________

TLD # ___________ Grp. # _____ Badge date ___________ Issue date ___________ Return date ___________

TLD # ___________ Grp. # _____ Badge date ___________ Issue date ___________ Return date ___________

ATTACHMENT 10.5

REQUEST FOR REPORT OF RADIATION HISTORY

REQUEST FOR REPORT OF RADIATION HISTORY

Date ______________________________

Company ______________________________

____

____

____

Attention ______________________________

Please provide any internal and/or external dose history for the person below.

Name ______________________________

SSN ______________________________

DOB ______________________________

Time Period ❑ All Years ❑ ____________ to ____________

Stated Time Frame

I hereby authorize the release of the requested information to Weiss Associates. I acknowledge that copies of this form and signature are valid.

Signature Authorization **Date:**

Reports should include exposure information such as hot particle exposures, planned special exposures, etc., as applicable. This information is requested in accordance with 10 CFR 835, Final 11/98.

Please address your reply to:

Weiss Associates,
Attention: Kim Warren, Dosimetry Manager,
UC Davis, Old Davis Road,
ITEH Bldg., Davis, CA 95616,
Fax (530) 752-6918
Phone (530) 752-1348
(Please follow-up any faxed response with a hard copy.)

Thank you,

Kim Warren
Dosimetry Manager

ATTACHMENT 10.6

TRAINING CERTIFICATE LIST

TRAINING CERTIFICATE LIST

Required certificates must be on file in SHSO office before work can begin

REQUIRED TRAINING CERTIFICATE LIST (Training addressed in the PHSP Section 14 & 18)

- **OSHA 40 hour:** 29 CFR 1910.120
- **OSHA-8-hour-Refresher:** 29 CFR 1910.120
- **Radiation Worker** (RW): 10 CFR 835
- **Radiation Worker Refresher:**(RWR), 10 CFR 835
- **Core**[1]: 29 CFR 1910 General Industry Standards, 29 CFR 1926 Construction Safety, 10 CFR 835 Occupational Radiation Protection Program
- **Medical Exam:** PHSP Section 18.1, 29 CFR 1910.120f

SUPPLEMENTAL TRAINING CERTIFICATE LIS (Individual's Applicable Certificates Filed)

- **Bioassay:** PHSP 18.3
- **Respiratory Fit Test:** 29 CFR 1910.134
- **Escort Trained:** 10 CFR 835
- **OSHA 8 hour Supervisor:** 29 CFR 1910.120
- **General Employee Radiation Training (GERT):** 10 CFR 835
- **Radiation Control Technician (RCT):** 10 CFR 835
- **Radiation Control Technician (RCT Oral exam):** 10 CFR 835
- **Adult CPR: annual:** 29 CFR 1910.1030
- **1st Aid: every 3 years:** 29 CFR 1910.10
- **Excavation Competent Person:** 29 CFR part 1926, Subpart P.
- **Excavations and Trenches:** CCR Title 8 1504, 1539-1547
- **Nuclear Density Gaug**e: as required by U S Nuclear Regulatory Commission
- **Hazardous Transportation Broker:** 49 CFR Part 173, subpart H
- **Confined Space:**
- **Radiation Safety Officer (RSO):** 10 CFR 835
- **Radiation Safety Officer (RSO refresher):** 10 CFR 835
- **Blood Born Pathogen: one time** 29 CFR 1910.10
- **Whole Body Count (WBC)** PHSP 18.3
- **Letter of Notification copy:** 10 CFR 835
- **Radiation History Request copy:** 10 CFR 835
- **Off-site Radiation History copy:** 10 CFR 835

1. Core: Site Specific Core Training

Medical

Medical Services and First Aid, Respiratory Protection, Heat Stress

Emergency Response

Employee Emergency Plans and Fire Prevention Plans, Accidental Prevention Signs and Tags, Contingency Plan, and General Emergency Procedures,

Health & Safety

Project Health and Safety Plan, Health and Safety Procedures
Labels of Injurious Substances, PPE, Proposition 65 Issues, HWP,

Miscellaneous Valley Elderberry Longhorn Beetle Mitigation

Radiological Protection

Radiological Protection Procedures, Rev. 0,1/30/98, ALARA Program, ALARA Training, Embryo/Fetus

Hazard Communication

HMIS Hazardous Materials Identification System, Preparation of Hazardous Materials for Transport

Construction

Safety Training and Education, Emergency Medical Services and First Aid, Specific Excavation Requirements, Protection Systems at Excavations, Electrical Safety, Quality Assurance Protection Program

EXTERNAL DOSIMETRY ISSUANCE

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

The purpose of this external dosimetry issuance procedure is to document issuance wear, care use, reporting and records relating to personnel dosimeters that have been issued at LEHR in accordance with SOP 38.1 (Reference 2.2) and HPS 15.1 (Reference 2.4) for conformance with 10CFR835 (Reference 2.1). LEHR has submitted to DOE an exception to DOELAP accreditation request and presently uses a laboratory for dosimetry which is NVLAP certified.

2.0 REFERENCES

2.1 *10 CFR 835 - "Occupational Radiation Protection Program," Final Rule, November 4, 1998*

2.2 *SOP 38.1 Check-In and Orientation for General Employees, Radiological Workers, and Members of the Public*

2.3 *SOP 38.3, Radiation Protection Records*

2.4 *HSP 15.1, External Radiation Exposure Control*

2.5 *Technical Basis for Monitoring of External Dose to Individuals*

2.6 *TLD Service Documentation, Radiation Detection Company, California Dosimetry Vendor*

3.0 DEFINITIONS

3.1 Committed Dose Equivalent

Committed dose equivalent is the dose equivalent calculated to be received by a tissue or organ over a 50 year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem (or sievert) (1 rem =0.01 sievert).

3.2 Committed Effective Dose Equivalent

The sum of the committed dose equivalents to various tissues in the body ($H_{T,50}$), each multiplied by the appropriate weighting factor (w_T)--that is, $H_{E,50} = \Sigma w_T H_{T,50}$. Committed effective dose equivalent is expressed in units of rem (or sievert).

3.3 Controlled Area

Any area to which access is managed by DOE or for DOE to protect individuals from exposure to radiation and/or radioactive materials.

3.4 Deep Dose Equivalent

Deep Dose Equivalent is the dose equivalent derived from external radiation at a depth of 1 centimeter in tissue.

3.5 Dose

Is a general term for absorbed dose, dose equivalent, effective dose, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent as defined in 10 CFR 835 definitions.

3.6 Dosimeter

A portable instrument for measuring and registering the total accumulated exposure to ionizing radiation.

3.7 Dosimetry

The theory and application of the principles and techniques involved in the measurement and recording of radiation doses. Its practical aspect is concerned with the use of various types of radiation instruments with which measurements are made.

3.8 Effective Dose Equivalent

The summation of the products of the dose equivalent received by specified tissues of the body (H_T) and the appropriate weighting factor (w_T)--that is, $H_E = \Sigma w_T H_T$. It includes the dose from radiation sources internal and/or external to the body. For purposes of compliance with 10 CFR 835, deep dose equivalent to the whole body may be used as effective dose equivalent for external exposures. The effective dose equivalent is expressed in units of rem (or sievert).

3.9 High Radiation Area

Any area, accessible to individuals, in which radiation levels could result in an individual receiving an deep dose equivalent, (effective dose equivalent to the whole body), in excess of 0.1 rem (0.001 Sievert) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

3.10 Ion

An atom that has too many or too few electrons, causing it to be chemically active; an electron that is not associated (in orbit) with the nucleus.

3.11 Ionizing radiation

Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Examples: alpha, beta, gamma, e-rays and neutrons.

3.12 National Voluntary Laboratory Accreditation Program (NVLAP)

Adheres to compliance with Title 15, Part 295 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q 92-1987) for ionizing radiation dosimetry. Current certificate on file in SHSO office.

3.13 Radiation Area

Any area, accessible to individuals, in which radiation levels could result in an individual receiving an deep dose equivalent, (effective dose equivalent to the whole body), in excess of 0.005 rem (0.05 millisievert) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

3.14 Radiological Worker

Radiation Worker is a general employee whose job assignment involves operation of radiation producing devices or working with radioactive materials, or who is likely to be routinely occupationally exposed above 0.1 rem (0.001 sievert) per year total effective dose equivalent.

3.15 Spare Badge or Spare TLD

A group of generic TLDs are ordered for issuance to radiological workers new to the LEHR site. Each TLD has a unique identifier, but no preprinted name.

3.16 Supplemental Dosimetry

Supplemental Dosimeters include, but are not limited to, electronic dosimeters, pocket dosimeter, and other self-reading, alarming dosimeters. Supplemental dosimeters are required for any individual entering a High Radiation Area,10 CFR 835.502a(1), and recommended when a person could exceed 10% of an administrative control level from external radiation in one work day.

3.17 Thermoluminescent Dosimeter (TLD)

LEHR uses Radiation Detection Company, (dosimetry vendor) Type 09, XBG (x-ray, beta, gamma) badge, containing two lithium fluoride TLD-100 capsules as detection elements and a single TLD chip to enable monitoring of beta radiation and beta/photon mixtures (Reference 2.6).

3.18 Total Effective Dose Equivalent (TEDE)

Total Effective Dose Equivalent (TEDE) is the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

3.19 Whole Body

Whole Body, for the purposes of external exposure, is the head, trunk (including male gonads), arms above and including the elbow, or legs above and including the knee.

4.0 RESPONSIBILITIES

4.1 Project Manager (PM)

The Project Manager (PM) is responsible for the safe and effective implementation of this procedure.

4.2 Radiological Control Manager (RCM)

The RCM shall ensure that the implementation of this procedure is consistent with 10CFR835, DOE Orders/Guidelines and LEHR project requirements. The RCM is also responsible for other assignments as noted throughout this procedure.

4.3 Site Health and Safety Officer (SHSO)

Site Health and Safety Officer (SHSO) is responsible for managing the dosimetry program, for communication with the dosimetry vendor, ordering dosimeters, new radiation worker dosimeter issuance and dosimeter collection from terminating individuals, quarterly frequency of TLD supply exchange with the dosimeter vendor. The SHSO will keep two supplies of dosimeters:

- A supply of preprinted badges for radiological workers working a full quarter or more.
- A supply of generic badges for any radiological workers coming to LEHR in between the quarter frequency.

The SHSO is responsible for ensuring appropriate check-in and orientation of LEHR site personnel. (Reference 2.2). The SHSO is also responsible for other assignments as noted throughout this procedure. The SHSO performs the duties of a Dosimetry Program Manager and reports to the RCM. The SHSO is responsible for ensuring that LEHR on-site personnel have followed applicable sections of external dosimetry related procedures (Reference 2.2, 2.3 and 2.4).

The SHSO is responsible for maintaining a dosimeter storage area in a low background area for issued dosimeters not in use. The SHSO is responsible for ensuring that all radiological workers are trained to this procedure and understand its requirements. The SHSO is responsible for ensuring: the tracking of all reported radiological worker employment changes; the collecting of all TLDs from terminated employees; and, the return of TLDs with individuals full name and departure date.

4.4 Radiation Safety Officer (RSO)

The RSO is responsible for ensuring all radiological workers are wearing required dosimetry prior to entry into any posted radiation area or per Hazardous Work Permit (HWP) requirement. The RSO is responsible for ensuring that LEHR site personnel covered by 10 CFR 835.402(a) are provided with and use personnel dosimetry for their assigned tasks. The RSO is also responsible for other assignments as noted throughout this procedure. The RSO reports to the RCM and provides the SHSO with necessary technical direction.

4.5 Site Personnel

Radiological workers are responsible for wearing issued dosimeters as required by 10 CFR 835. Each individual is responsible for returning his/her TLD to the designated storage area at the end of the work day. Each individual is responsible for returning his/her TLD to the RSO at the time of his/her work assignment termination at LEHR

5.0 SAFETY PRECAUTIONS/PREREQUISITES

- The SHSO shall obtain radiation history from all radiological workers prior to dosimetry issuance.
- The radiation history of a radiological worker showing the current year history will be requested from the previous radiological work site(s) or an estimate of the current year signed by the radiological worker will suffice until records are retrieved from the previous radiological work sites.
- All issued dosimeters must be in calibration and comply with the requirements of the NVLAP for individual usage.

- A copy of the Dosimeter Vendor's current NVLAP certificate is on file in the SHSO office.
- Exposure from background, therapeutic and diagnostic medical radiation and voluntary participation in medical research program shall not be included in radiation history records or in the assessment of compliance with the occupational exposure limits.

6.0 PROCEDURE

6.1 Issuance of Dosimetry

6.1.1 Designation of the LEHR site personnel to be issued dosimeters is detailed in LEHR HSP 15.1, External Radiation Exposure Control (Reference 2.4) and Technical Basis for Monitoring of External Dose to Individuals (Reference 2.5).

6.1.2 The SHSO shall not issue dosimeters to radiological workers who can not provide current year radiation history from prior radiological work sites or an estimate of current year radiation history. An estimate of current year radiation history will have the individual's authorized signature to verify that he provided an estimate during the interim of receiving the history from prior radiological sites or if those records can not be retrieved from prior radiological sites.

6.1.3 The SHSO shall maintain a log of all issued dosimeters. The log shall record, at a minimum, the individual's name, unique employee number, TLD identifier, and date of issuance.

6.2 Wearing and Use of Dosimetry

6.2.1 All radiological workers shall wear TLD's and/or supplemental dosimetry on the front of body between the neck and waist. Placement of the dosimeter can be modified by the RSO when normal location will not result in the potential whole-body dose being measure.

6.3 Proper Use and Care of Dosimeter

6.3.1 Thermoluminescent badges are stored with a control thermoluminescent group badge. The storage area must be equal to or less than background, ambient temperature, and away from direct sunlight. The storage area will be designated by the RSO. All thermoluminescent badges will be gathered at this spot at the beginning of each workday and returned at the end of each workday. Do <u>not</u> take the TLD off the site. Do <u>not</u> leave the TLD in your car. Do <u>not</u> immerse the TLD in water.

6.3.2 All radiological workers will return their TLDs to the RSO at the time of termination ***before*** leaving the LEHR site.

6.3.3 All TLDs will remain with the appropriate group control badge throughout the monitoring frequency. The SHSO will obtain worker termination dates from the RSO. This information will be compiled on a no-less-than-quarterly basis.

6.4 TLD Monitoring Period

6.4.1 The annual monitoring period is divided into quarter intervals with which the previous quarter TLDs are collected and new quarter TLDs are issued. The quarter intervals are as follow:

- First quarter-January 1 - March 31
- Second quarter-April 1 - June 30
- Third quarter-July 1 - September 30
- Fourth quarter October 1 – December 31

6.4.2 The SHSO receives the new quarter TLDs about one week before for the current quarter. The TLD's are counted and matched to the packing slip. The SHSO will contact the RSO during the arrival of the new batch of TLDs to give him a heads-up that an exchange will take place on the first of the month.

6.4.3 The SHSO shall exchange the previous quarter TLDs with the new quarter's TLDs. The previous quarter's TLDs will be QA (checked in) to the yellow field log book. The TLDs will be placed in vendors shipping materials and returned for processing.

6.4.4 Radiological worker job assignment termination before the end of the quarter.

- Radiological worker(s)will return their TLD(s) to the RSO. The RSO will return the necessary information and TLD(s) to the SHSO. The SHSO will check in (QA) the TLD(s) against the yellow log.
- Radiological workers that have terminated at LEHR within a month of the end of the quarter will be held and will be sent to the processor at the end of the monitoring quarter.

6.5 Dosimetry Reports

6.5.1 The SHSO will receive a quarterly report from the Dosimetry Vendor for the monitored individuals. The reports will be filed in the SHSO office after review.

6.5.2 The SHSO will request a termination report for the monitored individual(s) that have left the site and will not return within the monitor year. The report will be reviewed and the SHSO will send a copy of the termination report to the monitored individual in a timely manner.

6.5.3 The SHSO and RSO will discuss any abnormal or unexpected results compared to prior reports. The RSO will make a dose estimate for a monitored individual if an error has been determined. The dose estimate will be documented and filed with the monitored individuals site records.

7.0 LOST DOSIMETRY

Lost dosimetry shall be reported to the RSO and SHSO immediately. The RSO will fill out a lost dosimeter form and will calculate the estimated dose. The lost dosimeter form and associated estimated dose calculations will be filed in the RIDS personnel files.

8.0 RECORDS

All dosimetry records and dose histories are to be maintained as required by SOP 38.3, Radiation Protection Records (Reference 2.3)

9.0 ATTACHMENTS

None.

RADIATION PROTECTION RECORDS

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

The purpose of this procedure is to describe records maintenance and retention for Radiation Protection Records.

2.0 REFERENCES

2.1 *10 CFR 835 - "Occupational Radiation Protection Program"*

2.2 *HSP 15.1 - "External Radiation Exposure Control"*

2.3 *HSP 16.1 - "Internal Dosimetry Procedure"*

2.4 *HSP 18.1 - "Personnel Contamination"*

2.5 *HSP 19.1 - "Embryo-Fetus Protection Program"*

2.6 *SOP 25.1 - "Radiological Surveys and Instrumentation"*

2.7 *SOP 38.1 - " Check-in and Orientation for General Employees, Radiological Workers, and Members of the Public"*

2.8 *SOP 38.2 - "External Dosimetry Issuance"*

2.9 *SOP 38.4 - "Radiological Protection Program Audits"*

3.0 DEFINITIONS

3.1 *Records Inventory and Disposition Schedule (RIDS)*

4.0 RESPONSIBILITIES

4.1 Project Manager (PM)

The Project Manager PM is responsible for the effective implementation of this procedure.

4.2 Radiological Control Manager (RCM)

The Radiological Control Manager (RCM) is responsible for ensuring all dosimetry and radiological protection records are maintained pursuant to the requirements of this procedure.

4.3 Radiation Safety Officer (RSO)

The Radiation Safety Officer (RSO) is responsible for ensuring that all internal and skin dose calculations, and radiation protection records are reviewed. All reviewed records will be retained according to this procedure.

4.4 Site Health and Safety Officer (SHSO)

The Site Health and Safety Officer (SHSO) is responsible for record retention as required by this procedure and for providing applicable records for review by the RSO (or other designated radiation protection personnel).

5.0 SAFETY PRECAUTIONS/PREREQUISITES

None.

6.0 PROCEDURE

6.1 Radiological Survey Records

Copies of radiological survey records are retained in the RSO working files. The original is retained in the RIDS LEHR Project files.

6.1.1 Equipment and radioactive shipment surveys can be retained in the RSO working files and transferred to RIDS LEHR Project files, no less than annually.

6.1.2 Equipment and radioactive shipment surveys can be retained in the RSO working files and transferred no less than annually to the RIDS LEHR Project files.

6.2 Radiological Instruments and Equipment

6.2.1 All copies of radiological instruments and equipment maintenance and calibration results records (Reference 2.6) will be retained in the RSO working files and will be transferred, no less than annually, to the RIDS LEHR Project files for archiving.

6.2.2 Equipment, techniques, and procedure document changes used for monitoring the workplace will be retained in the RSO working files and transferred no less than annually to the RIDS LEHR Project files.

6.3 Individual Monitoring Records

6.3.1 All copies of dose estimates for all skin contamination as required by HSP 18.1, "Personnel Contamination" (Reference 2.4), can be retained in the RSO working files and the original retained in the RIDS LEHR Project files.

6.3.2 Copies of dose estimates for all internal exposures (Reference 2.3) and external exposures (Reference 2.2 and 2.8) can be retained in the RSO working files and the original retained in the RIDS LEHR Project files.

6.3.3 All skin contamination dose estimate records and all internal dose estimate records including all data used in the estimates shall retained in the Personnel section of the RIDS LEHR Project files.

6.4 Administrative Records

6.4.1 All records generated in performance of the Occupational Radiation Protection Program assessments and audits shall be maintained in accordance with the requirements as outlined in SOP 38.4, "Radiological Protection Program Audits" (Reference 2.9).

6.4.2 Completed Declaration of Pregnancy forms or revocation of Declaration of Pregnancy forms shall be kept in the Personnel section of the RIDS LEHR Project files (Reference 2.5).

6.4.3 The following lists some of the employee training records required by federal regulation (Reference 2.7). These records and similar records are retained in the RIDS LEHR Project files:

- General Employee radiological training
- Radiological worker training
- Periodic retraining
- Radiation Worker training

6.4.4 Actions taken to maintain occupational exposures as-low-as-reasonably-achievable, including the actions required by 10 CFR 835 (Reference 2.1), as well as administrative control actions required by 10 CFR 835, shall be documented and documentation shall be retained in the RIDS LEHR Project files.

7.0 DOCUMENTATION/RECORDS

7.1 *Records shall be maintained to document compliance with 10 CFR 835, Occupational Radiation Protection Program and with Radiation Protection Programs required by 835.101.*

7.2 *All records listed in this procedure are to be retained until final disposition is authorized by the DOE as per 10 CFR 835.701.*

7.3 *All records required by this section shall be retained until transferred to the DOE upon cessation of activities at the site that could cause exposure to individuals.*

7.4 *Unless otherwise specified, radiological control records shall use the special units of curie, roentgen, rad, and rem, including multiples of these units or as otherwise provided within 10CFR835.*

7.5 *Individual Monitoring Records shall be maintained to document doses received by all individuals for whom monitoring was required pursuant to 10 CFR 835.402 unplanned doses exceeding the monitoring thresholds of 10 CFR 835.402.*

7.6 *Individual Monitoring Records shall be sufficient to evaluate compliance with subpart C of 10 CFR 835*

7.7 *Individual Monitoring Records shall include the dose equivalent to the embryo/fetus of a declared pregnant worker.*

7.8 *The records specified in this section that are identified with a specific individual shall be readily available to that individual.*

7.9 *Data necessary to allow future verification or reassessment of the recorded doses shall be recorded.*

7.10 *All documentation and records will be collected, maintained and retained according to 10 CFR 835 subpart H.*

7.11 *The individual monitoring records shall be sufficient to evaluate compliance with Section 835.202.*

7.12 *The individual monitoring records shall be sufficient to provide dose information necessary to complete reports required by subpart I of 10 CFR 835 and by*

Departmental requirements for occurrence reporting and processing, to include person, social security number or a unique identification number.

7.13 *The individual monitoring records required by this section shall include the following quantities for external dose received during the year:*

- the effective dose equivalent from external sources of radiation (deep dose equivalent may be used as effective dose equivalent for external exposure);
- the lens of the eye dose equivalent;
- the shallow dose equivalent to the skin; and,
- the shallow dose equivalent to the extremities.

7.14 *The individual monitoring records shall include the following quantities for internal dose resulting from intakes received during the year:*

- committed effective dose equivalent;
- committed dose equivalent to any organ or tissue of concern; and,
- estimated intake and identity of radionuclides.

7.15 *The individual monitoring records shall include the following quantities for the summation of the external and internal dose:*

- total effective dose equivalent in a year;
- for any organ or tissue assigned an internal dose during the year, the sum of the deep dose equivalent from external exposures and the committed dose equivalent to that organ or tissue; and,
- cumulative total effective dose equivalent.

7.16 *Documentation of all occupational exposure received during the current year shall be obtained when demonstrating compliance with Section 835.202 (a).*

7.17 *The results of individual external and internal dose measurements that are performed but are not required by Section 835.402 shall be recorded. Recording of the non-uniform shallow dose equivalent to the skin caused by contamination on the skin (see Section 835.205) is not required if the dose is less than 2 percent of the limit specified for the skin in Section 835.202(a) (4).*

7.18 *Results of monitoring for radiation and radioactive material shall be conducted as required by subparts E and L of 10 CFR 835, except for monitoring required by §*

835.1102(d). Results of monitoring shall be used to determine individual occupational dose from external and internal sources if required by 10CFR835.

7.19 *Records shall be maintained as necessary to demonstrate compliance with the requirements of 835.1201 and 835.1202 for sealed radioactive source control, inventory, and source leak tests.*

8.0 ATTACHMENTS

None.

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.

RADIOLOGICAL PROTECTION PROGRAM AUDITS

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and requirements for performing internal audits of the LEHR Radiation Protection Program (RPP) as required by 10 CFR 835.102, and Section 18 of the Quality Assurance Project Plan.

- 10 CFR 835.102 states that "Internal audits of the radiation protection program, including examination of program content and implementation, shall be conducted through a process that ensures that all functional elements are reviewed no less frequently than every 36 months"
- Section 18 of the QAPP states that "... Planned and scheduled audits will be performed to verify compliance with all aspects of this document, SAP and Work Plan(s), as applicable" to the LEHR RPP

2.0 REFERENCES

2.1 *10 CFR 835 "Occupational Radiation Protection"*

2.2 *Quality Assurance Project Plan (QAPP)*

2.3 *SQP 4.2 - "Records Management"*

2.4 *SQP 12.1 – "Quality Audits"*

2.5 *LEHR Radiological Protection Program (RPP)*

3.0 DEFINITIONS

3.1 Audit

A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents, and the effectiveness of implementation. An audit should not be confused with surveillance or inspection activities performed for the sole purpose of process control or product acceptance.

3.2 Assessment (Audit) Team

One or more persons who are responsible for audit performance and reporting. The team may consist of, or is headed by, an individual designated as the Audit Team Leader (ATL).

3.3 Assessment (Audit) Team Leader (ATL)

The individual responsible who organizes and directs the audit, coordinates the preparation and issuance of the Audit Report, and evaluates and performs follow-up of responses.

3.4 Technical Specialist

One or more persons who are assigned to the audit team due to the specialized or technical aspects of the areas to be audited. Technical Specialists are selected based on their special abilities, specialized technical training, and/or prior experience in the specialized or technical aspects of the area to be audited.

3.5 Finding

A documented statement of fact concerning a noncompliance or deviation from established requirements.

3.6 Observation

A statement of fact regarding the potential for a noncompliance which could lead to a more serious problem if not identified and/or corrected, but which does not constitute a lack of compliance with established requirements.

4.0 RESPONSIBILITIES

Compliance with this procedure is the responsibility of the Radiological Control Manager (RCM) as indicated in the LEHR RPP (Reference 2.5) and Project Management and Quality Assurance Organization personnel as outlined in the QAPP (Reference 2.2).

4.1 Program Manager

The Program Manager will assess the integrated Quality Management Systems Performance and effectiveness.

4.2 Project Manager (PM)

The PM is responsible for the approval and implementation of this procedure.

4.3 Radiological Control Manager (RCM)

The RCM, or designee, is responsible for ensuring regulatory and operational compliance with the requirements of this procedure. The RCM is also responsible for coordinating and ensuring RPP assessments (e.g., surveillance, audit, inspection) of project activities are performed in compliance with the LEHR RPP (Reference 2.5) and procedures.

4.4 Project Quality Assurance Manager (PQAM)

The PQAM is responsible for implementing quality aspects of the RPP and following up on findings or observations which involve or impact the Quality Assurance Program.

4.5 Project Records Administrator (PRA)

The PRA is responsible for maintaining the records required in this procedure.

4.6 Radiation Safety Officer (RSO)

The RSO is responsible for assisting in scheduling of resources to participate in RPP assessments.

5.0 SAFETY PRECAUTIONS/PREREQUISITES

- In conducting audits, the requirements of the RPP, PHSP, HWP's or any other applicable control documents shall be complied with by audit personnel.
- The audit program shall involve qualified personnel (e.g., Radiation Protection personnel, Health & Safety personnel etc.), as needed to assist in any radiological areas of concern (i.e., Controlled Areas, Contamination Areas, etc.) in performance of audit.

6.0 PROCEDURE

6.1 Discussion

6.1.1 Internal assessments of the LEHR RPP content and implementation shall be performed to verify and document compliance with requirements of 10 CFR 835 (Reference 2.1) and the QAPP, as applicable to the LEHR RPP. These assessments are set on cycles that ensure all functional elements are reviewed no less frequently than every 36 months. See Attachment 8.1 for indicated assessment (audit) cycles. These audits should consist of a review of appropriate manuals implementing procedures (SOPs, HSPs, SQPs), their application, content, and implementation at LEHR, including records.

6.1.2 Assessments should be conducted by qualified members of the Quality Assurance Organization or other third party organization in coordination with the RCM. Coordination of all audits is the responsibility of the RCM or designee and will involve co-operation and input from the PQAM and site Radiation Safety Officer (RSO) in determining scheduling and availability of resources involved.

6.1.3 SQP 12.1 (Reference 2.4) should be used as a guide in conducting audits.

6.1.4 The RPP assessment party shall have an audit plan that, at a minimum, includes a checklist of requirements to be used to evaluate compliance.

6.1.5 Notification should be made to RCM or designee prior to performing assessment. The assessment shall be documented in an appropriate report as required by QAPP (Reference 2.2).

6.2 Audit Response

6.2.1 Upon completion of an audit, any observations or finding shall be addressed by the RCM or designee.

7.0 DOCUMENTATION/RECORDS

7.1 *Records generated as a result of audits shall be maintained to document compliance with the requirements as outlined in 10 CFR 835.*

7.2 *Records generated as a result of this procedure will be Quality Control Records and will be controlled and maintained in the project records files in accordance with SQP 4.2 (Reference 2.3). These records include the following:*

- Audit plans;
- Audit reports;
- Correction Action reports, including response, evaluation, and verification;
- Audit closure letter;
- Correspondence related to the audit; and,
- RPP audit checklists.

8.0 ATTACHMENTS

8.1 Audit Plan Schedule

ATTACHMENT 8.1

AUDIT PLAN SCHEDULE

ATTACHMENT 8.1

RPP AUDIT PLAN SCHEDULE

10 CFR 835 Subpart	Title	Audit Cycle Year
A	General Provisions	1
B	Management and Administrative Requirements	1
C	(Reserved)	N/A
D	(Reserved)	N/A
E	Monitoring of Individuals and Measurements	2
F	Entry Control Program	2
G	Posting and Labeling Log	2
H	Records	1
I	Reports to Individuals	1
J	Radiation Safety Training	2
K	Design and Control	3
L	Radioactive Contamination Control	3
M	Sealed Radioactive Source Control	3
N	Emergency Exposure Situations	3

[1)] Variations in audit cycle may occur to facilitate an expedited audit schedule.

OCCUPATIONAL EXPOSURE REPORTS

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure describes the requirements for the reporting of personnel exposures to chemicals, radiation, radioactive material, or other hazardous materials encountered during environmental assessment and decontamination and decommissioning activities at the LEHR facility. DOE sites are required to submit the results of occupational radiation exposure monitoring to DOE Headquarters on an annual basis in accordance with DOE Order 231-1 (Reference 2.3). The format and content of the reports are specified in DOE Manual 231-1.1 Appendix G.

2.0 REFERENCES

2.1 *10 CFR 835, "Occupational Radiation Protection Program"*

2.2 *29 CFR 1910, "Occupational Safety and Health Standards," and 1926, "Safety and Health Regulations for Construction"*

2.3 *DOE Order 231.1*

2.4 *DOE ORDER Manual 231.1, September 1995*

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

4.1 The Project Manager (PM)

The PM is responsible for the effective implementation of this procedure.

4.2 The Radiological Control Manager (RCM)

The RCM is responsible for ensuring employee exposure reports are prepared and provided to site personnel pursuant to the requirements of this procedure and of applicable federal regulations.

4.3 The Site Health and Safety Officer (SHSO)

The SHSO is responsible for ensuring that employee exposure reports (chemical, industrial hygiene, or radiation dose) are included into personnel files and that a copy of the report is sent to the individual, as required by federal regulations.

5.0 SAFETY PRECAUTIONS/PREREQUISITES

None.

6.0 PROCEDURE

6.1 Chemical Exposure Reports

6.1.1 A copy of any industrial hygiene monitoring results for chemicals addressed in the substance specific standards of 29 CFR 1910 or 1926 (Reference 2.2) will be provided to the affected employee(s) by the SHSO within five (5) working days after receipt of the results.

6.1.2 Original industrial hygiene monitoring results shall be retained in the project files.

6.1.3 A copy of any industrial hygiene monitoring results for chemicals not specifically identified by a substance specific standard will be retained in project files, and a copy will be posted by the SHSO in the SHSO's office and the Radiation Safety Office.

6.2 Radiation Exposure Data

6.2.1 Radiation exposure data for individuals monitored in accordance with 10 CFR 835.402 (Reference 2.1) shall be reported as specified in this section. The information shall include the data required under 10 CFR 835.702(c). Each notification and report shall be in writing and include:

- The DOE site or facility name,
- The name of the individual,
- An individual's unique identification number, such as the individual's social security number, employee number, or other unique identification number

6.2.2 Upon the request from an individual terminating employment, records of exposure shall be provided to that individual as soon as the data are available, but not later than 90 days after termination.

A written estimate of the radiation dose received by that employee based on available information shall be provided at the time of termination, if requested.

6.2.3 Each DOE or DOE-contractor-operated site for facility shall, on an annual basis, provide a radiation dose report to each individual monitored during the year at that site or facility in accordance with 10 CFR 835.402.

- DOE sites are required to submit the results of occupational radiation exposure monitoring to DOE Headquarters on an annual basis in accordance with DOE Order 231.1.
- The format and content of the reports are specified in DOE Manual 231-1.1 Appendix G.

6.2.4 REMedit Validation:

- Refer to the web site http:// rems.eh.gov.\reportin.1 for current report update.

6.2.5 Detailed information concerning any individuals' exposure shall be made available to the individual upon request of that individual, consistent with the provisions of the Privacy Act of 1974.

6.2.6 When a DOE contractor is required to report to the Department, pursuant, to Departmental requirements for occurrence reporting and processing, any exposure of an individual to radiation and/or radioactive material, or planned special exposure in accordance the 10 CFR 835.204(e), the contractor shall also provide that individual with a report on his or her exposure data included therein. Such report shall be transmitted at a time not later than the transmittal to the Department.

6.3 Hazard Communication

6.3.1 The SHSO or Radiation Safety Officer (RSO) shall inform all site personnel of the presence of new chemicals or hazardous materials brought onto the project site.

7.0 DOCUMENTATION/RECORDS

Copies of reports shall be documented and maintained in accordance with SOP 38.3, Dosimetry Program.

8.0 ATTACHMENTS

None.

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.

LEHR SITE INSPECTION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

The purpose of the LEHR Weekly site inspection is to check the DOE controlled buildings radiological waste storage areas, former dog pens areas, the non-operating mixed waste storage shed, the former Imhoff area and the fenced in southwest corner of the site for entry control. The degree of control shall be commensurate with existing and potential radiological hazards, storage of radiological waste, storage of chemical hazards or storage of other hazardous materials encountered during environmental assessment and decontamination/decommissioning activities at the LEHR facility. One or more of the following methods shall be used to ensure control:

- Signs and barricades;
- Control devices on entrances;
- Conspicuous visual and/or audible alarms;
- Locked entrance way; or,
- Administrative controls.

2.0 REFERENCES

2.1 SQP 7.1, Receipt Inspection

3.0 RESPONSIBILITIES

3.1 Project Manager

The Project Manager is responsible for ensuring the following:

- the LEHR Site Inspections are conducted in accordance with this procedure and any other appropriate procedures.
- Addresses/advises corrective actions for weekly outstanding issues reported by the inspector.

3.2 Radiation Safety Officer

The Radiation Safety Officer is responsible for ensuring the following:

- Appropriate controls are maintained and verified which prevent the inadvertent transfer of removable contamination to locations outside of radiological areas during and the period of time between field operations;
- Posting appropriate radiological signs and barricades;
- Radiological control devices on entrances; and,
- Conspicuous visual and/or audible alarms for radiological areas, if alarms are installed on site.

3.3 Waste Coordinator

The Waste Coordinator is responsible for ensuring the following:

- The LEHR Site Inspection is performed;
- The completed LEHR Site Inspection form is retained in the LEHR project files; and,
- Proper storage of low-level radiological waste, hazardous waste, and radiological mixed waste.

3.4 Site Health and Safety Officer

The Health and Safety officer is responsible for ensuring that the Radiation Safety Officer is notified before any one enters any radiological controlled area.

4.0 SAFETY PRECAUTIONS/PREREQUISITES

4.1 Specific Hazards

Insect bites, physiological stress from exposure to hot or cold weather; and, potential slip, trip, and falls.

4.2 Proper Protective Clothing

Level D-work clothes (long sleeve shirt, long pants, steel toe shoes), eye and hearing protection in areas requiring it.

5.0 PROCEDURE

5.1 LEHR Site Inspections

Performed weekly, or as necessary to assess any adverse effects from occurrences such as heavy rainstorms, windstorms power outages.

Performed as required by SQP 7.2 (Reference 2.1).

5.2 Corrective Actions

Copy any outstanding issues to the Project Manager and Waste Coordinator.

Copy corrective action documentation follow-up to the Project Manager and Waste Coordinator.

6.0 DOCUMENTATION/RECORDS

6.1 LEHR Site Inspection Form

The most current version of the LEHR Site Inspection Form and completed LEHR Site Inspections shall be kept in the LEHR Project Files. Completed LEHR Site Inspections shall also be copied to the Project Manager, and any requesting subcontractor.

7.0 ATTACHMENTS

None.

A form referenced or attached to this procedure may be replaced with a substitute form, with the approval of the RCM or RSO, if the substitute form contains equivalent information as the referenced form.

* * EXAMPLE * *
Waste Management Program Inspection Sheet

Note: Evaluation column will be left blank (S-U-) when subcontractors are performing work.

	Location	Evaluation S	Evaluation U	Comments	Work Order
A.	**BUILDING # OR AREA**	**S**	**U**	Inspector:	Date: Time:
1.	Item to be checked	☐	☐		
2.	Item to be checked	☐	☐		
3.	Item to be checked	☐	☐		
4.	Item to be checked	☐	☐		
5.	Item to be checked	☐	☐		
6.	Item to be checked	☐	☐		
B.	**BUILDING # OR AREA**	**S**	**U**	Inspector:	Date: Time:
1.	Item to be checked	☐	☐		
2.	Item to be checked	☐	☐		
3.	Item to be checked	☐	☐		
4.	Item to be checked	☐	☐		
5.	Item to be checked	☐	☐		
6.	Item to be checked	☐	☐		
C.	**BUILDING # OR AREA**	**S**	**U**	Inspector:	Date: Time:
1.	Item to be checked	☐	☐		
2.	Item to be checked	☐	☐		
3.	Item to be checked	☐	☐		
4.	Item to be checked	☐	☐		
5.	Item to be checked	☐	☐		
6.	Item to be checked	☐	☐		

* * EXAMPLE * *
Waste Management Program Inspection Sheet

Note: Evaluation column will be left blank (S-U-) when subcontractors are performing work.

Location	Evaluation	Comments	Work Order

AMBIENT RADIATION MONITORING PROGRAM INSPECTION AND REPORTING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This procedure covers inspection and reporting requirements of the Ambient Radiation Monitoring Program, utilizing Thermoluminescent Dosimeters (TLDs) at the Laboratory for Energy-Related Health Research (LEHR) Site. TLDs are radiation detection devices used for measuring exposure from external gamma and high energy beta radiation in the environment. Location of TLDs are specified in Attachments 9.1 and 9.2. They are inspected quarterly to verify that the TLDs are in place and intact. Each week the Geriatric I, Mixed Waste Storage Facility, Imhoff and background TLDs are checked and measured with a bicron meter.

The procedure is designed to ensure that the program meets the requirements in the LEHR Site Environmental Monitoring and Surveillance Plan; DOE Order 5400.1 "General Environmental Protection Requirements," Chapter IV, "Environmental Monitoring Requirements"; and the DOE Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance.

2.0 REFERENCES

2.1 *ANSI Standard N13.6-1972. Occupational Radiation Exposure Records System*

2.2 *ANSI Standard N543-1974. General Safety Standard for Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies Up to 10 MeV*

2.3 *ANSI Standard N545-1975. Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry (Environmental Applications)*

2.4 *DOE Order 5400.1, August 1989. General Environmental Protection Requirements*

2.5 *Environmental Management Operations, September 1993. Environmental Monitoring and Surveillance Plan for the Laboratory for Energy-Related Health Research Environmental Restoration Project, Office of Environmental Restoration and Waste Management, U.S Department of Energy, San Francisco*

2.6 *US Department of Energy, January 1991. DOE Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*

3.0 DEFINITIONS

3.1 Thermoluminescent dosimeters (TLDs)

A type of radiation detection device often used for environmental radiation measurements. When a TLD is exposed to ionizing radiation, energized electrons are transferred and absorbed on to the phosphor atoms within the badge. Upon analysis, heat is used to release the trapped electrons in the form of a photon. The intensity of the light is proportional to the radiation dose received.

3.2 Monitoring Location

Location in the environment at which a TLD is placed for the purpose of obtaining the exposure measurement of interest. The monitoring location shall be chosen to be as representative as possible of the general surroundings. Acceptable sites include physically and radiologically uniform open areas not shielded by adjacent structures. Acceptable methods of suspension include hanging from wire fence, small tree or shrub, or post as stated in ANSI N545-1975. A map with TLD locations is included in the Site Environmental Monitoring and Surveillance Plan.

4.0 PROCEDURE

4.1 Locations and Placement

The locations for TLDs at the LEHR Site are described in Attachment 9.1 and a map is provided in Attachment 9.2. All locations are defined in the Site Environmental Monitoring and Surveillance Plan.

TLDs are placed at a height of 1-meter above ground level. DOE Environmental Regulatory Guide states that in the field, the TLDs shall be suspended at a height of 1.0 meter ± 0.3 meter above the ground in a manner that will minimize distortion of the radiation field. If other heights are used, justification will be provided in the Site Environmental Monitoring Plan. The TLDs are mounted either in a plastic mesh cylinder attached to wall mountings by security seals or attached to a fence or wall with a clip. Each TLD has a printed label with an identification number that is specific to each location.

4.2 Thermoluminescent Dosimeter Inspections

Inspection of TLDs shall be performed once a week at the specific sites described in Attachment 9.1.

4.2.1 Equipment and Materials Needed

- TLD Location Map (Attachment 9.2)
- Environmental Dosimetry Weekly Inspection form (Attachment 9.1)
- Clipboard
- Bicron Micro-Analyst Survey Meter (Micro R Meter)
- Bike (if desired) and bike helmet
- Keys: DOE and bike.
- Black or blue pen for recording information on the inspection form.

4.2.2 Instructions for Completing the Inspection

- Obtain a new inspection form, Attachment 9.1. Put your name and date at the top of the form. Use only black or blue ink pen.
- Refer to Attachment 9.2, which identifies all site TLD locations. Go to each location and complete the inspection by performing the following checks:
    - Verify that the TLD is present and securely attached. Check TLD package, holder and container for tears, cracks or holes, insure that numbers match those on inspection sheet. For TLDs with wooden mountings, check paint on screws to verify that it is intact and not cracked.
    - Verify that security seals are intact and that numbers match those printed on the inspection form.
- If the TLD is secure and in place, and all items above are checked, place your initials on the Environmental Dosimetry Inspection Sheet in the "Group Number" column for the TLD you are inspecting.
- Using the Micro R Meter, take a reading of the radiation field present at the TLD location. The measurement point must be within 5 cm of the TLD holder or package.

  This measurement shall be recorded weekly at all TLD locations in radioactive storage areas and at the background location. All other TLD locations shall be measured quarterly for the presence of radiation fields.
- If any problems or unusual conditions are noted during the inspection, describe details in the "Comment or Corrective Action" column of the inspection form. If any condition was corrected, initial and date the last two columns. These columns are also used during quarterly exchange as described in Section 4.3.

- Submit the inspection sheet to the SHSO for review, and discuss any problems noted during the inspection.

4.3 Exchanging the TLDs

4.3.1 Dosimeters are exchanged on a quarterly basis. The Environmental Dosimetry Weekly Inspection sheet is the form used for quarterly exchange. Whenever an exchange takes place, the new TLD needs to be positioned at the same location and height as the previous TLD.

4.3.2 The State Department of Health Services (DHS) has a Direct Radiation Monitoring (duplicate sample) Program for selected locations at the LEHR Site. Their program of exchange has been synchronized with our quarterly exchange program in order to compare data. A representative from the state comes out each quarter to exchange DHS TLDs.

- The new TLDs are obtained from the Radiation Detection Company.
- Before going into the field, the new TLDs shall be inspected for condition and correct identification.
- Go to each TLD location on Attachment 9.2. If a TLD is housed in a security cylinder, remove the seal from one end. Inspect in accordance with paragraph 4.2.2 of this procedure. After verifying that all information is correct, put a new TLD (and security seal, if applicable) in place. Note this action in comments block on inspection sheet (Attachment 9.1). Initial and date corrective action blocks. Cross out the old security seal number and write the new security seal number next to the cross-out and initial.
- After returning from the field, verify condition and identification information on each TLD collected as you check off and date the appropriate line on the Environmental Dosimetry Inspection sheet.
- Return the collected TLDs and a copy of the Environmental Dosimetry Weekly Inspection sheet to the Radiation Detection Company. The original goes to the SHSO.

5.0 RECORDS AND REPORTING

Records that establish the conditions under which individuals potentially were exposed, such as facility radiological conditions, shall be kept to provide a chronological, historical record pursuant to Section 5 of ANSI N13.6-1972. TLD records are valuable documentation of potential exposure within a specific location. Original weekly inspection sheets are maintained within the SHSO records, and a copy is provided to the prime contractor as part of the weekly site inspection report.

All record entries shall be made in black or blue waterproof ink. Changes to records shall be made by placing one line through the incorrect entry and clearly writing in the correct information. The change shall include the initials of the person correcting the entry and the date the change was made.

If too many changes are necessary and/or the clarity of the document is compromised, it shall be marked as superseded and stapled to a revised and correct version of the document.

Analytical results from laboratory analyses are reviewed for accuracy when received. The analytical results are tabulated and reviewed for trends using standard statistical methods. Should any analytical result show an abnormally high or low result, an investigation will be promptly initiated to validate the result and/or learn the cause of the abnormal result. Results of the investigation shall be described in the monthly Environmental Monitoring Report.

5.1 Record Maintenance

5.1.1 The Environmental Dosimetry Weekly Inspection Sheet (Attachment 9.1) is used for the weekly inspection and the quarterly dosimetry exchange. The inspector provides the completed form to the SHSO for review and signature. The original is filed in the SHSO files.

5.1.2 Lost Dosimetry Reports are maintained in the Health and Safety files.

5.1.3 Copies of lab reports are filed in the SHSO office.

5.2 Weekly Reporting

Results of weekly dosimetry inspections are reported to the prime contractor and become part of project records. A brief summary of findings is provided in a cover letter to the prime contractor's Project Manager. A copy of the weekly inspection form (Attachment 9.1) is also provided. Problems or discrepancies of significance to the program that were noted during the inspection are described in the cover letter.

5.3 Monthly and Quarterly Reporting

A brief overview of significant aspects of the ambient radiation monitoring program shall be included in a monthly report to the prime contractor. At the time that the report from the analysis laboratory is received, significant unexpected readings shall be reported as soon as possible to project management by the Environmental Monitoring Coordinator. If no significant or unexpected readings require immediate attention, results of the latest quarterly dosimetry reports from the laboratory are provided to project management through the monthly Environmental Monitoring Report.

TLD measurements of exposure can be used to estimate the potential for human exposure at a particular TLD location. Each TLD location receiving a reported dose above background shall be identified. A review of weekly or periodic radiological measurements taken at the location shall be compared with the reported TLD result. Significant discrepancies between these measurements are reported and investigated.

Calculations to determine potential exposure of an individual in the vicinity of the TLD shall be developed, based on the reported TLD dose and actual field measurements for that location. Calculations shall be provided in the report for each above background result for TLDs located in an area where personnel could have been exposed. If two or more TLDs have similar locations (radiological storage areas that are infrequently visited, for example), a calculation may be necessary only for the highest TLD reading, as long as the calculated potential dose is well below one fourth (for a quarterly measurement) the annual site goal for exposure limits as defined in the Site Radiological Control Manual.

Calculations shall be based on a reasonable estimate of occupancy for the TLD location, using the occupancy factor for the individual who is likely to have spent the greatest amount of time in that location. Actual results for personnel exposure shall be compared (if available) whenever the calculated potential dose reaches one quarter of the exposure limit action level (site goal for worker exposure) defined in Table 2-1 of the Site Radiological Control Manual. For locations where site personnel spend very little time and definitive occupancy data are not available, (stairways, outside areas used only for pedestrians or vehicular traffic, etc.) ANSI-N543-1974, Appendix A, Table 2 suggests an occupancy factor of 1/16 of a workday.

In order to provide fullest implementation of DOE policy to assure exposure remains As Low As Reasonably Achievable (ALARA), results of the above calculations shall be evaluated to determine whether additional engineering controls need to be incorporated in order to reduce exposure. The monthly report should state whether such action is needed or has been taken.

5.4 Annual Reporting

An annual review of results for the ambient radiation program for the LEHR Site is included within the Annual Site Environmental Report, published by the Department of Energy (DOE). Guidance for this report is prepared annually by DOE, as a supplement to the report requirements defined in DOE Order 5400.1 *General Environmental Monitoring Program.*

6.0 QUALITY ASSURANCE

Quality assurance of field and laboratory activities shall be verified through the use of control dosimeters, duplicates, a testing program that involves exposure of TLDs to a determined level of radiation, and through actual field measurements taken monthly or weekly at each TLD location. Laboratory quality assurance shall be monitored within an approved laboratory accreditation program, such as the National Voluntary Laboratory Accreditation Program (NVLAP).

6.1 Control Dosimeters

Control dosimeters are kept in the SHSO office. They are used to verify that TLDs receive no inadvertent exposure to radiation during shipment to and from the analysis laboratory. Comparison of results from duplicate samples taken by DHS should also be included in an evaluation of quality assurance data for the ambient radiation monitoring program.

7.0 SAFETY

Primary guidance for health and safety concerns during TLD inspection is found in the Project Work Element Health and Safety Plan. This section of the procedure is intended to supplement that document and provide specific safety information regarding the measurement process.

7.1 Personal Protective Equipment (PPE) Requirements

Check with supervising contractor on PPE requirements prior to entering specially designated environmental remediation project work zones or any areas where a Hazardous Work Permit (HWP) is in effect.

7.1.1 Head Protection

No head protection is required for routine implementation of this procedure. A hard hat will be worn when inspecting around heavy equipment or when inspecting in a controlled area where HWP specifies a hard hat requirement. A bike helmet will be worn while riding a bicycle, if this method of transportation is selected.

7.1.2 Ear Protection

Ear protection is not needed during normal monitoring conditions. Ear protection is required in an area where a HWP stipulates ear protection due to heavy equipment operation or other loud activities.

7.1.3 Foot Protection

Closed-toed shoes with non-slip soles. (Wear steel toe shoes in areas where posted.)

7.1.4 Hand Protection

Hand protection is not necessary during inspection.

7.1.5 Body Protection

Long pants shall be worn during the inspection to help protect from wind or sun exposure and scrapes from falls or vegetation.

7.2 Physical Hazards

7.2.1 Slip, Trip, Fall Hazards: Inspections may be performed in areas where other work is being performed. Care should be taken to note equipment, power cords, large rocks, or other items which may contribute to trips or falls. Use extra caution when walking on wet or slippery surfaces.

7.2.2 Ionizing Radiation: Ionizing radiation has been used in the past in specific areas of the Site, and project activities may involve remediation of these areas, and/or storage of hazardous materials. During inspection activities, it is important to obey signs that designate areas where access may be controlled. A dosimetry badge will be worn in areas that are controlled for radioactive purposes.

7.2.3 Ultraviolet Radiation: Ultraviolet light is a non-ionizing radiation present in sunlight that can cause sunburn as well as inflammation of the skin and cornea of the eye. People react to ultraviolet radiation in different ways, so take the appropriate measures to limit exposure to manageable doses. The following is a list of some of the ways to protect from getting too much ultraviolet radiation: The following items are recommended, but not required, during the inspection:

- Wear eye protection. Dark lenses are available on-site, which meet eye protection requirements. Even clear lenses block some ultraviolet light.
- Wear a hat and lab coat to reduce sun exposure on face and neck.
- Use sunblock on ears, nose, and other areas where the skin might burn.

7.2.4 Heat Stress: Inspection activities require longer outdoor exposure than an individual may normally be accustomed to. The adverse stress to the body due to exposure to excess heat can greatly diminish the ability of the body to function properly. Wearing protective equipment may further increase the possibility of heat stress. Knowing how to recognize such stress and how to prevent it will help to assure that inspection activities do not lead to such effects.

7.3 Biological Hazards

7.3.1 Animal Bites and Stings: Animal bites and stings are usually a nuisance, causing localized swelling, itching and minor pain, which can be handled with first aid treatment. However, some situations may be more serious and require immediate medical treatment. Notify supervision if any of the following problems are encountered.

<u>Large Animal Bites</u> - A bite from a dog, cat, rodent or other mammal may cause an open wound characterized by punctures, lacerations, and avulsions (tearing). All animal bites carry a risk of infection. Cat, rodent or other mammal bites may be as dangerous as a dog bite due to the wider variety of bacteria present in the mouth of such animals. Many wild animals including bats, raccoons and rats can transmit rabies in a bite. Tetanus is another danger of animal bites.

<u>Snake Bites</u> - Snakebites are more likely to occur in spring and summer months in areas usually undisturbed by daily human activities. Rattlesnakes are commonly found in grassy areas, around wood piles and in rocky areas. Because they are cold blooded, they may be found in cool shady

areas during hot weather, and warm sunny areas during cool weather. Poisonous snake bites require immediate medical attention. The best precaution is to make a noise (vibration) while working and never place your hands and feet where visibility is not clear.

Ant, Bee, Hornet, Wasp, and Yellow Jacket Stings - Stings from bees and wasps are more common than other insect stings. The health effects from a sting are caused by poison injected into the victim. Symptoms associated with stings may be localized, systemic, or both. Approximately five percent of the population is hypersensitive to bee, ant or wasp venom. Insect stings may need first aid treatment or immediate medical attention, depending on the situation.

Spider Bites - Many species of spiders may bite, but both the Black Widow and Brown Recluse spiders produce poisonous bites. Both spiders can be found locally, usually in areas which are normally undisturbed. Spider bites may require first aid treatment or medical attention, depending on the situation. Identification of the spider is important in diagnosing potential health effects. To prevent spider bites, never place your hands and feet in places where visibility is not clear.

8.0 RECORDS

None

9.0 ATTACHMENTS

9.1 Environmental Dosimetry Inspection Form

9.2 Thermoluminescent Dosimeter Location Map

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 9.1

ENVIRONMENTAL DOSIMETRY INSPECTION FORM

Environmental Dosimetry Inspection

Inspected by and Date: ______________________________

Battery: _______ **Background:** _______________ **Source/ Source Check:** __ 1uCi Cs-137, 03-92-0502.

Instrument/ Calibration Date: Bicron m analyst SN# A919N - 1/19/98

*TLD # Location	RDC** #	Security Seal #s		Field µR/hr	TLD in place	Badge Name	Location Description
TLD-1	*9900*	*260*	*717*			*NW-1*	*Northwest corner of site*
TLD-2	*9901*	*675*	*380*			*NE-2*	*Northeast corner of site*
TLD-3	9902					BRTR-3	LEHR ER Brown Project Trailer
TLD-4	9903	353	214			NCC-4	East side of North Cargo Container
TLD-6	***9904***	***393***	***218***			***MWS-6***	***East side of Mixed Waste Storage Shed***
TLD-7	9905	240	222			CO60-7	West portion of north fence of former Co-60 field
TLD-8	9906	335	205			CO60-8	North portion of east fence of former Co-60 field
TLD-9	*9907*	*253*	*263*			*CO60-9*	*South portion of east fence of former Co-60 field*
TLD-11	9908	664	226			CO60-11	West portion of south fence of former Co-60 field
TLD-12	9909					CO60-12	Middle of west fence of former Co-60 field
TLD-13	9910					CO60-13	Northwest Corner of former Co-60 field
TLD-14	**9911**	**228**	**276**			**SoGeri-14**	**South side of H-29 (rad waste storage- rws)**
TLD-15	**9912**	**252**	**201**			**EGeri-15**	**East side of H-292 (rws)**
TLD-16	**9913**					**NGeri-16**	**North wall inside H-292 (rws)**
TLD-17	**9914**	**388**	**269**			**WGeri-17**	**West side of H-292 (rws)**
TLD-18	9915	776	305			EDog-18	Between east and west dog pens on east fence
TLD-19	*9916*	*219*	*376*			*SSite-19*	*South site boundary, south of west dog pen*
TLD-20	*9917*	*773*	*229*			*SW-20*	*Southwest corner of site*
TLD-21	9918	234	296			FenSpec-21	Fence west of west dog pen, near Spec Stor. (H-216)
TLD-23	9919	233	389			AH2-23	AH-2 Door (310a)
TLD-24	*9920*	*336*	*255*			*SWAH2-24*	*Southwest of Southwest corner of AH-2*
TLD-25	9921	203	0617			WFen-25	Fence-West site boundary, west of Imhoff area
TLD-26	*9922*	*660*	*202*			*AH1-26*	*West entrance door of AH-1 (H-219)*
TLD-29	**9923**	**317**	**217**			**Imh-29**	**Imhoff area, pole attachment**
TLD-35	**9924**	**629**	**387**			**Bkg-35**	**Background (Bkg) UCD Equine Center**
TLD-36	9925					Control-36	SEALED LEAD PIG IN SHSO OFFICE

TLD #	Date	Init.	Comments or Corrective Action (CA) required

Italics =TLD locations monitored by the Department of Health Services.

(black) =TLDs without security containers.

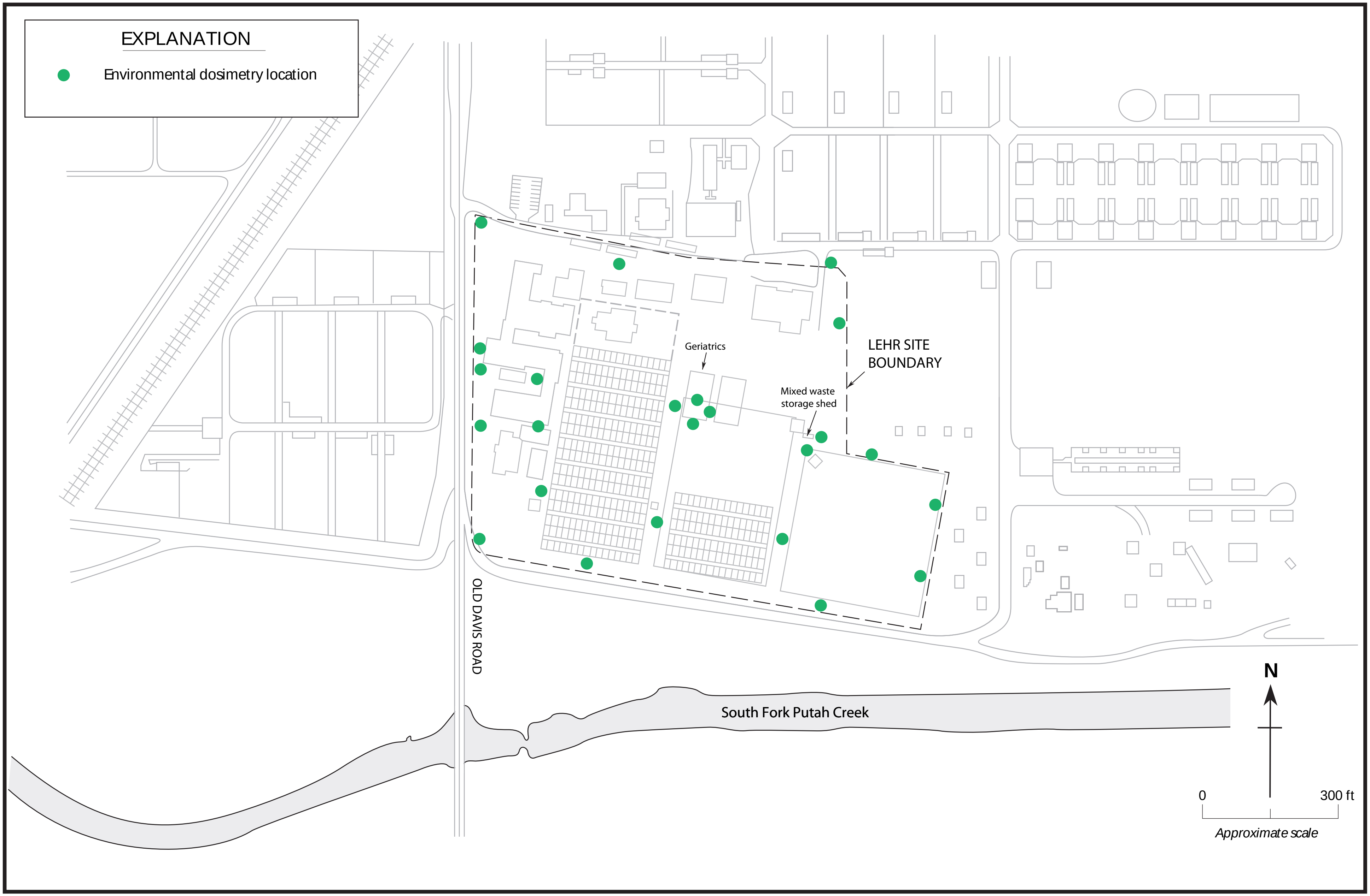
(grey) =Rad storage TLD locations. Inspected weekly with a rad field measurement instrument.

*TLD Location # corresponds with TLD Location Map

**RDC=Radiation Detection Company

ATTACHMENT 9.2

THERMOLUMINESCENT DOSIMETER LOCATION MAP



TLD Locations

Weiss Associates

LA1a-033.ai 04/17/98

LEHR DOCUMENT REVIEW PROCEDURES

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for personnel to use when reviewing LEHR documents.

2.0 REFERENCES

None

3.0 DEFINITIONS

3.1 RWQCB

California Regional Water Quality Control Board – Central Valley Region

3.2 DTSC

California Environmental Protection Agency's Department of Toxic Substances Control

3.3 RPM

Remedial Project Managers

4.0 PROCEDURE

4.1 Internal Review

Prior to internal technical/peer review, the author is responsible for ensuring that a rigorous QA/QC review has been completed and recorded on the QA/QC checklist (Attachment 6.1). This checklist should accompany the report throughout the editing process. When the document is ready for technical/peer review, as determined by the author and/or Project Manager, the following actions will be taken:

1. Project Manager and Project Task Leader select the appropriate technical/peer reviewers and schedule review times with them. (For most

reports, this includes Project Manager and Project Quality Assurance Manager at a minimum.)

2. Author, or an assigned member of the project staff, completes the required portions of the Document Review Tracking Form (DRTF) (Attachment 6.2) and sends a copy of the document to the reviewer. The document copy should contain those components required for a proper review.
3. Each reviewer examines the document and records any comments or corrections in the reviewer's document copy, or in a separate written memo or Email.
4. Reviewer and author discuss each major comment noted on reviewer’s document copy. If agreement cannot be reached, the Project Manager will make the final decision.
5. Reviewer signs and dates the DRTF approving the agreed-upon corrections.
6. Author makes the agreed-upon corrections.
7. When all comments/corrections have been addressed, the author then signs the "Review Closed" portion of the DRTF.
8. If approval signatures are required on the document (for Final documents but not Draft or Draft Final documents), each individual in the approval chain signs the approval page.

4.2 DOE and UCD Review

When the Draft document is ready for DOE-OAK, DOE-HQ, and/or UC Davis review, as determined by the author and/or Project Manager, the following actions will be taken:

1. Project Manager determines the appropriate external reviewers and schedules review times and due dates with them.
2. The document copy should contain those components required for a proper review. Author records date sent on DRTF.
3. Each reviewer examines the document and records any comments or corrections on the document, or in a written memo or Email.
4. Reviewer sends comments to the author. Author records receipt date on DRTF.
5. Author reviews comments and discusses them with Reviewer, as necessary. Author makes the agreed-upon corrections, and returns written responses or a corrected copy of the document to the reviewer. Author records date responses sent on DRTF.
6. When all comments/corrections have been addressed, the author then signs the "Review Closed" portion of the DRTF.

7. If approval signatures are required on the document (for Final documents but not Draft or Draft Final documents), each individual in the approval chain signs the approval page.
8. Author submits to the Project Records Administrator (PRA) the completed DRTF along with the office copies of the client-ready Draft and Draft Final documents.
9. The PRA dates the bottom of the page as to the receipt of document and logs all forms and documents into the project files. (All internal review draft documents will be recycled).

4.3 Other RPM Review

Review comments from the US EPA, RWQCB, DTSC, and other RPMs may be submitted in a variety of formats, both written and verbal. To the extent possible, the author and/or Project Manager should document all RPM comments and responses to comments, and this documentation should be included in the project files.

5.0 RECORDS

None

6.0 ATTACHMENTS

6.1 QA/QC Checklist

6.2 Document Review Tracking Form

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

QA/QC CHECKLIST

Attachment 6.1

QUALITY CONTROL/QUALITY ASSURANCE CHECK LIST FOR DOCUMENTS

For each LEHR document, this check list must be attached behind the “pink sheet” when it is first submitted to the AAs for editing. It must be filled out and remain with the document throughout the editing process.

ITEMS TO BE QA/QC’D	REVIEW COMPLETED Reviewer’s initials/date	CORRECTIONS MADE AND VERIFIED Reviewer’s initials/date
Does document conform to WA Document Style Manual?		
Are cover pages in proper LEHR format?		
Are headers and footers correct (especially page #s) and in LEHR format?		
Does Table of Contents (TOC) match headings in report?		
Do page numbers in TOC agree with actual text, figures, tables, etc.?		
Do figure captions, table headers, appendix title sheets agree with TOC?		
Are figures and tables properly cited in text (i.e., first citations are in numerical order, and all number citations are correct)?		
Are all data entries in text, supporting tables, and/or figures consistent with one another?		
Are all Section references correct?		
Are reference citations included in References section?		
Is format consistent in References section?		
Are all Appendices complete and included in the proper order?		
Was Spell Check completed?		
Was report checked for typos, grammar?		

ATTACHMENT 6.2

DOCUMENT REVIEW TRACKING FORM

DOCUMENT REVIEW TRACKING FORM

Document Title: ______________________ Job No.: ______________

Project Manager: ______________ Project Task Leader: ______________ Lead Author: ______________

This portion of the form will be completed by the Lead Author. Attach additional pages if necessary.

Version [1]	Reviewer [2]	Title/ Organization	Date Sent to Reviewer	Date Comments Received	Revision Concurrence [3]	Comments

Date Review Closed: [4] ______________ Initials: __________

Date Received by Records Administrator: [5] ______________ Initials: __________

Notes:

[1] List alphabetical revision designation for draft documents or numeric revision designation for final documents.

[2] List names of reviewers selected by the Project Manager and Project Task Leader.

[3] The reviewer will document their concurrence by initialing and dating this field. If concurrence is not provided in-person, the author shall list the reviewers initials, date of concurrence, and indicate method of verifying concurrence (e.g., via telephone or e-mail) in the "Comments" field.

[4] Review is closed when all reviewers have acknowledged their concurrence.

[5] When completed, this form will be submitted to the Records Administrator for inclusion in the project file. The Records Administrator will provide a copy of the completed form to the signatories of the final document.

ENVIRONMENT, SAFETY AND HEALTH REPORTING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the methods and responsibilities for reporting environment, health and safety information required by DOE Order 231.1.

2.0 REFERENCES

2.1 *DOE Order 231.1, Chg. 2, 9/30/97*

2.2 *DOE Manual 231.1-1 Chg. 2, 01/28/00*

2.3 *29 Code of Federal Regulations (CFR) 1904.2, 1904.5, 1904.11, 1904.12, 1904.14, 1904.21*

2.4 *29 CFR 1904.7 and 29 CFR Subpart 1960.71*

3.0 DEFINITIONS

4.0 RESPONSIBILITIES

4.1 Project Manager

It is the Project Manager's (PM's) responsibility to ensure that all required reports are submitted to the cognizant organizations and regulatory agencies within the mandated timeframes.

4.2 Project Records Administrator

The Project Records Administrator (PRA) is responsible for the maintenance and organization of all reports generated in compliance with this SOP.

4.3 Property Manager

The Property Manager is responsible for the tracking, inventory and maintenance of the DOE property in excess of $5,000.

4.4 Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) is responsible for accident and radiological exposure reporting.

4.5 Project Health and Safety Manager

The Project Health and Safety Manager oversees the SHSO and ensures that the LEHR health and safety (H&S) program is in compliance with relevant laws, regulations, DOE Orders and prudent accepted practices.

4.6 Delegation

Responsibilities may delegated, but delegations must be documented. The PM is responsible for ensuring the person to whom the work is delegated has qualifications commensurate with the responsibilities being assigned.

5.0 APPLICABLITY

This SOP applies to all work performed at LEHR.

6.0 REPORTING OF ENVIRONMENTAL PROTECTION INFORMATION

6.1 Annual Site Environmental Report

A Site Environmental Report must be prepared for each calendar year. It shall present summary environmental data to:

(1) Characterize site environmental management performance, including data on effluent releases, environmental monitoring, and estimates of radiological doses to the public associated with releases of radioactive material;

(2) Summarize any environmental occurrences and responses that were reported during the calendar year;

(3) Confirm compliance with environmental standards and requirements; and

(4) Highlight significant programs and efforts, including environmental performance indicators and/or performance measurement programs.

The Annual Site Environmental Report (ASER) should be approved by the DOE-Oakland Operations Office Manager or appropriate designee and released to the public by October 1. The report should cover the activities of the previous calendar year. Content and format of the ASER should be consistent with latest DOE Guidance.

7.0 REPORTING OF OCCUPATIONAL SAFETY AND HEALTH INFORMATION

7.1 Work-Related Fatalities, Injuries, and Illnesses

The SHSO shall record, in accordance with 29 CFR 1904.2 through 1904.5, 1904.11, 1904.12, 1904.14, and 1904.21, occupational fatalities, injuries, and illnesses occurring as a result of work primarily performed at DOE-owned or -leased facilities. The SHSO shall comply with guidance provided in the latest edition of the Department of Labor (DOL) publication, Office of Management and Budget (OMB) No. 1220-0029, "Recordkeeping Guidelines for Occupational Injuries and Illnesses."

DOE Form 5484.3, "Individual Accident/Incident Report" (Attachment 12.1) shall be used in lieu of the "Supplementary Record of Occupational Injuries and Illnesses" (Occupational Safety and Health Administration [OSHA] Form No. 101). Forms shall be submitted in accordance with Paragraph 7.4 below.

7.2 Recording and Reporting Work-Related Damage or Loss of Property and Vehicles Due to Accidents

The Property Manager shall record and report estimated loss or damage to DOE property or other property valued at $5,000 or more, or estimated costs of $5,000 or more, for cleaning (including decontamination), renovating, replacing, rehabilitating structures, equipment, or property.

Estimated damage of $1,000 or more that involves Federal Government-owned, -rented, or -leased vehicles or privately owned vehicles operated while on official business shall be considered a "recordable case" and shall be reported.

Excluded are commercial rental motor vehicles and private motor vehicles used for short periods of time (1 to 14 days) by employees on official travel status, and on which mileage records are not kept.

Work-related property and vehicle damage or loss shall be recorded on DOE Form 5484.3 (Attachment 12.1) and reported in accordance with Paragraph 7.4 below.

Guidelines governing loss estimation and criteria for determining property valuation are provided in Attachment 12.3.

7.3 Reporting Subcontractor Accident Information

The SHSO shall report accident information (DOE Forms 5484.3 and 5484.4) for subcontractors who perform work on DOE-owned or -leased facilities. DOE Form 5484.4, "Tabulation of Work-Hours, Vehicle Usage, and Property Valuation," (Attachment 12.4) should be completed by the PM and submitted only for subcontracts with more than $10,000 in estimated cost. All recordable injuries or illnesses must be reported on DOE Form 5484.3, regardless of the cost of the subcontract.

7.4 Submittal of DOE Form 5484.3, "Individual Accident/Incident Report"

A legible copy of each new or revised report shall be submitted quarterly (on or before the 25th of each April, July, October, and January) for receipt by the Computerized Accident/Incident Reporting System (CAIRS) Data Coordinator. Reports should be submitted on or before the 25th of the month following the end of the quarter in which the accident occurred, or in which information is received that changes the extent or outcome of a previously reported case.

The reports shall be addressed to the CAIRS Data Coordinator, U.S. Department of Energy, EH-72, Building 270 Corporate Center, 19901 Germantown Road, Germantown, Maryland 20874-1290.

Each transmittal of reports to the CAIRS Data Coordinator shall include a cover sheet. Attachment 12.2 provides a listing of the information that shall be included in the cover sheet and the suggested format.

7.5 Submittal of Work Hours and Vehicle Usage

Part A of DOE Form 5484.4, "Tabulation of Work-Hours, Vehicle Usage, and Property Valuation," (Attachment 12.4) shall be used to report quarterly work hours and vehicle usage.

The PM shall complete and mail the form to the CAIRS Data Coordinator, U.S. Department of Energy, EH-72, Building 270 Corporate Center, 19901 Germantown Road, Germantown, Maryland 20874-1290.

The form shall be mailed to the CAIRS Data Coordinator for receipt on or before the 25th of each January, April, July and October.

7.6 DOE Annual Estimated Property Valuation

Part B of DOE Form 5484.4, "Tabulation of Work-Hours, Vehicle Usage, and Property Valuation," (Attachment 12.4) shall be used by the Property Manager to report estimated replacement value of all DOE-owned property under LEHR site jurisdiction. The Property Manager shall complete and submit estimates of property valuation to the CAIRS Data Coordinator, U.S. Department of Energy, EH-72, Building 270 Corporate Center, 19901 Germantown Road, Germantown, Maryland 20874-1290 for receipt on or before March 31, annually.

7.7 Retention and Maintenance of Accident Records and Reports

The PRA shall ensure that accident reports and related records are retained, maintained, and accessible in accordance with the requirements indicated in this SOP and DOE Manual 231.1-1.

The PRA shall retain personal injury, illness, property, and vehicle damage files pursuant to DOE Order 1324.5B, Records Management Program. Upon termination of contracts with DOE at DOE-owned or -leased facilities, the PM shall render accident records to the contract organization assuming occupational safety and health (OSH) responsibilities for the facility. DOE contractors assuming OSH responsibilities at a DOE-owned or -leased facility shall retain accident records of the previous operating contractor.

7.8 Access to Accident Records and Reports

Employees, former employees, and their representatives have the right to access "The Log and Summary of Occupational Injuries and Illnesses," OSHA Form No. 200. Employees, former employees, and/or their representatives shall be allowed access to any DOE Form 5484.3 that contains their name or the name of the employee they represent. Additional information on employee rights of access to these forms is provided in 29 CFR 1904.7 and 29 CFR Subpart 1960.71.

Records provided in 29 CFR 1904.2, 1904.4, and 1904.5 (or the DOE equivalent of these records) shall be made available for inspection and copying by any DOE representative for the purpose of conducting oversight assessments or for statistical compilation.

Requests to access accident records and reports should be in writing.

Records required to be maintained under the provisions of 29 CFR Subparts 1960.67, 1960.68, and 1960.69 shall be made available to the Secretary of Labor, Secretary of Health and Human Services, and/or their authorized representatives.

8.0 ANNUAL SUMMARY OF FIRE DAMAGE

The LEHR PM shall submit an annual report of fire damage to the DOE fire protection authority having jurisdiction (ES&H/OAK) by March 31 of the following calendar year. The annual summary of fire damage shall contain the detail described in Attachment 12.5. The individual functional reports should be summarized into a combined report that addresses all of the fire protection reporting requirements delineated in this attachment. Attachment 12.3 provides guidelines governing loss estimation and should be used to determine fire loss.

9.0 REPORTING INFORMATION FOR EPIDEMIOLOGIC ANALYSES—EXCESS INJURIES AND ILLNESSES

The Project Health and Safety Manager or the PM shall notify the DOE Oakland Operations Office of suspected excesses of illnesses or injuries that require epidemiologic analyses. Suspected excess in this context means the perception that an unusually high number of cases may be occurring among a group of workers. Epidemiologic analyses help determine if suspected excesses of illnesses or injuries are greater than expected and associated with working conditions.

Any worker, individual, or group (for example, safety and health staff, supervisors, or employee representatives) can identify suspected excesses of illnesses and injuries.

The reporting organization participates in epidemiologic investigation directed by the DOE Assistant Secretary of Environment, Safety and Health, which will determine the number of affected individuals, their medical diagnoses, and their hazardous exposures. The investigation may require medical tests, work place surveys, and reviews of personnel, medical, and exposure records.

9.1 Reporting Information for Epidemiologic Analyses—OSH Studies

The PM shall provide Centers for Disease Control officials, State health officials, their contractors, and grantees access to the DOE-sponsored facilities, workers, information, and data needed to conduct these OSH studies. The investigators shall comply with Privacy Act and security requirements.

9.2 Reporting Performance Indicator Data

The PM shall report performance indicator data on a quarterly (calendar year) basis to the Office of Operating Experience Analysis and Feedback (EH-33).

10.0 REPORTING IONIZING RADIATION EXPOSURE INFORMATION

The LEHR Radiation Protection Program requires ionizing radiation exposure monitoring under certain conditions. If such monitoring is performed, any exposure data collected is reported in accordance with SOP 38.5 Occupational Exposure Records and/or SOP 38.3, Radiation Protection Program Records. The reporting procedures in this SOP supplement the LEHR Radiation Protection Program and associated SOPs.

10.1 Interim Exposure Data Reporting

Radiological exposure data pertaining to a DOE employee, a contractor supporting DOE Headquarters or Field Office activities, a Defense Nuclear Facilities Safety Board employee or contractor, or an International Atomic Energy Agency inspector who visits a DOE or DOE contractor site or facility to conduct Department-related business shall be reported to the Radiation Records Repository within 30 days after determination of the dosimetry results by the SHSO.

Radiological exposure data pertaining to a visit by a DOE contractor employee shall be reported to the individual's employer within 30 days after determination of the dosimetry results by the SHSO.

Each DOE or DOE contractor employee who visits, in an official capacity, a radiological site outside of the DOE office shall arrange to have all pertinent occupational radiological exposure data reported to his or her employer within 30 days after determination of dosimetry results. SOP 38.2, External Dosimetry Issuance, provides requirements for reporting radiological exposure data to individuals.

10.2 Annual Exposure Data Reporting

The SHSO shall report radiological exposure data summaries to the Radiation Records Repository by March 31 for each individual monitored at his/her respective site for radiological exposure during the preceding calendar year.

10.3 Reporting Procedures

Radiological exposure data shall be:

- Prepared as directed by Attachment 12.6; and
- Reported to the Radiation Records Repository or an individual's employer, as appropriate.

10.4 Radiological Exposure Reports to Individuals

A radiological exposure report pertaining to a visit in accordance with Section 10.3 shall be provided to the individual at the same time such information is reported to the Radiation Records Repository.

A radiological exposure report pertaining to a visit by a member of the public to a DOE or DOE contractor site or facility shall be provided to that individual within 90 days of the visit end date.

Reports to individuals shall use the dose terms specified in 10 CFR 835.2.

Additional dose terms, if used, shall be included in parentheses adjacent to the standard terms or as a footnote to the report.

Use of the exposure report form in Attachment 12.6 for reporting radiological exposures to individuals is optional.

11.0 RECORDS

Records generated as a result of this SOP will be controlled and maintained in the project record files in accordance with Standard Quality Procedure 4.2, Records Management.

12.0 ATTACHMENTS

12.1 Individual Accident/Incident Report, DOE Form 5484.3

12.2 Transmittal of Individual Accident/Incident Reports

12.3 Guidelines Governing Loss Estimation and Criteria for Determining Property Valuation for Fire and Non-Fire Property Damage Accidents

12.4 Tabulation of Work-Hours, Vehicle Usage, and Property Valuation, DOE Form 5484.4

12.5 Annual Summary of Fire Damage Experience Report

12.6 Individual Occupational Exposure Report, DOE Form 5480.7

12.7 Instructions for Preparing Occupational Exposure Data Summaries

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 12.1

INDIVIDUAL ACCIDENT/INCIDENT REPORT FORM, DOE FORM 5484.3

DOE F 5484.3
(09-95)
All Other Editions
Are Obsolete

OMB Control No.
1910-0300

U.S. Department of Energy

INDIVIDUAL ACCIDENT/INCIDENT REPORT

Official Use Only - Privacy Act

For CAIRS Use Only

P.D. Accident Type |__|__| Energy Flow |__|__| |__|__| |__|__| |__|__|

Enter GICS ______________ Narrative ______________ FRASE Coding ______________ Revision: [] 1st [] 2nd [] 3rd [] 4th

General Information

1. Organization Name ______________________
   Organization Code |__|__|__|__|__|__|__|__|
2. Case Number |__|__|__|__|__|__|
3. Multiple Case Number |__|__|
4. Accident Type [] Injury/Illness [] Vehicle
   [] Property Damage [] Other
5. Investigation Type [] A [] B [] C [] Non-recordable
6. Department, Division, or I.D. Code ______________________
7. Date of Occurrence |__|__|__|__|__|__| (Month, Date, Year)
8. Time |__|__|__|__| (Military)
9. Accident Occurred [] Indoors [] Outdoors
10. On Employer's Premise [] Yes [] No
11. Specific Location ______________________

Employee Information

12. Check One: [] Injured/Ill Employee
    [] Operator of Equipment/Vehicle
13. Name ______________________
14. S.S./I.D. Number |__|__|__|__|__|__|__|__|__|__|
15. Age |__|__|
16. Sex: [] Female [] Male
17. Occupation ______________________
18. Length of present employment:
    [] Under 3 months [] 3 to 12 months [] Over 12 months
19. Experience on this job/equipment:
    [] Under 3 months [] 3 to 12 months [] Over 12 months

If Property Damage or Vehicle Accident, go to Line 26

Injury/Illness (OSHA Information)

20. [] Injury Code (10)
    [] Code 7a(21) - Skin disease or disorders
    [] Code 7b(22) - Dust diseases of lungs
    [] Code 7c(23) - Resp. due to toxic agents
    [] Code 7d(24) - Poisoning
    [] Code 7e(25) - Disorders-Physical agents
    [] Code 7f(26) - Disorders-Repeated trauma
    [] Code 7g(29) - All others
21. Workdays Lost |__|__|__|__|
22. Workdays Restricted |__|__|__|__|
23. Death [] Yes [] No
    If "Yes," enter date |__|__|__|__|__|__| (Month, Date, Year)
24. Permanent transfer to different job because of accident?
    [] Yes [] No
    Terminated because of accident?
    [] Yes [] No
25. Has employee returned to work with no further anticipated workdays lost or restricted?
    [] Yes [] No

Property/Vehicle Damage

26. Property [] Fire [] Non-Fire
    (If Property Damage Accident go to Line 30)
27. Vehicle [] Government
    [] Private - Driver by Government Employee
    [] Car/Pickup/Van/Motorcycle
    [] Truck (1 ton or over)
    [] Bus
    [] Other (Air, Marine, Railroad, etc.)
28. Was vehicle equipped with seat belts? [] Yes [] No
    If "Yes," was seat belt working properly? [] Yes [] No
29. Did vehicle accident involve recordable injury? [] Yes [] No
30. $ |__|__|__|__|__|__|__|__|__|__| Total Accident Damage
    $ |__|__|__|__|__|__|__|__|__|__| DOE Property/Vehicle
    $ |__|__|__|__|__|__|__|__|__|__| Non-DOE Property/Vehicle
31. $ |__|__|__|__|__|__|__| Claim against DOE $ |__|__|__|__|__|__|__| Paid by DOE
    $ |__|__|__|__|__|__|__| Reimbursed to DOE $ |__|__|__|__|__|__|__| Paid to DOE
32. Are the dollar amounts final? [] Yes [] No

Equipment/Hardware/Vehicle Involved (as applicable)

33. #1 Equipment ______________________ (Generic (or brand) name and model) |__|__|__|__|__|__|__|__|__|__| (Identification Number)
    #2 Equipment ______________________ (Generic (or brand) name and model) |__|__|__|__|__|__|__|__|__|__| (Identification Number)
34. Did equipment design or defect contribute to accident cause or severity? [] Yes [] No

DOE F 5484.3
(09-95)
All Other Editions Are Obsolete

OMB Control No. 1910-0300

NARRATIVE GUIDE

DO NOT INCLUDE THE NAME (OR OTHER PERSONAL IDENTIFIER) OF THE EMPLOYEE/OPERATOR OR WITNESS IN THIS SECTION. Use third person references, e.g., he slipped on the wet floor and broke his right toe.

35. Activity in progress at time of accident. Be specific. For example, if the employee was using tools or equipment or handling material, name them and tell what he was doing with them.

36. Events - Begin with initiating event and end with nature and extent of injury/damage. Name any objects or substances involved and tell how they were involved. Use a separate sheet for additional space.

Name and address of physician ______________________________

If hospitalized, name and address of hospital ______________________________

37. Accident Causes
 a. Conditions

 b. Actions

 c. Factors influencing a or b.

38. Corrective Actions (if risk is acceptable, corrective action may not be necessary)
 a. Actions taken

 b. Actions recommended

 c. To be completed by ______________________
 Implementation Date

39. Accident Investigator ______________________ Date __________ Telephone ______________

Official Position [ ] Supervisor [ ] Safety Professional [ ] Other ______________________

40. Supervisor responsible for Corrective Action ______________________ Date __________ Telephone ______________

41. Accident Investigation Contact
(if different from line 39) ______________________ Telephone ______________

Attachment to DOE Form 5484.3

Construction subcontractors working at Oak Ridge National Laboratory in Oak Ridge, Tennessee, should mail completed forms to:

Mr. Dell Morgan
Oak Ridge National Laboratory
P.O. Box 2008 MS 6340
Oak Ridge, TN 37831-6340

Forms may also be sent by facsimile to Mr. Morgan at (865) 576-2893 or hand-delivered to him in Building 1000, Oak Ridge National Laboratory.

All other subcontractors should mail completed forms to:

Ms. Carol Kendrick
Oak Ridge National Laboratory
P.O. Box 2008 MS 6348
Oak Ridge, TN 37831-6348

Forms may also be sent by facsimile to Ms. Kendrick at (865) 576-5372 or hand-delivered to her in Building 5500A, Room A-101, Oak Ridge National Laboratory.

ATTACHMENT 12.2

TRANSMITTAL OF
INDIVIDUAL ACCIDENT/INCIDENT REPORTS

TRANSMITTAL OF INDIVIDUAL ACCIDENT/INCIDENT REPORTS

Reporting Organization: ______________________________

Organization Code Number: ______________________________

Date of Transmittal: ______________________________

Number of New Accident/Incident Reports Included in Transmittal: ______________

(List by case number each report included in transmittal)

__________ __________ __________

__________ __________ __________

__________ __________ __________

__________ __________ __________

__________ __________ __________

__________ __________ __________

__________ __________ __________

__________ __________ __________

Number of New Accident/Incident Reports Included in Transmittal: ______________

(List by case number each report included in transmittal)

__________ __________ __________

__________ __________ __________

__________ __________ __________

__________ __________ __________

Contact Person:

Name: ______________________________

Phone Number: ______________________________

Address: ______________________________

ATTACHMENT 12.5

ANNUAL SUMMARY OF FIRE DAMAGE EXPERIENCE REPORT

	Item	Example Code or Data	Field Size (Characters)	Column Range
1.	Calendar Year	1995	4	1-4
2.	Social Security Number	123456789	9	5-13
3.	Name			
	a. First Name or Initial	JOHN	15	14-28
	b. Middle Name or Initial	Q	12	29-40
	c. Last Name	DOE	15	41-55
4.	Birth Year	1942	4	56-59
5.	Sex	M	1	60-60
6.	Begin Monitoring Date	010195	6	61-66
7.	End Monitoring Date	123195	6	67-72
8.	Monitoring Status	G	1	73-73
9.	Organization Code	0567002	7	74-80
10.	Facility Type Code	21	2	81-82
11.	Occupation Code	184	3	83-85
12.	Whole Body Dose			
	a. Total Effective Dose Equivalent	112	7	86-92
	b. Deep Dose Equivalent			
	- Including Neutron	100	7	93-99
	- Neutron Only	20	7	100-106
	c. Internal Dose			
	- Year of Intake	1995	4	107-110
	- Radionuclide(s)	AM241	15	111-125
	- Committed Effective Dose Equivalent	12	7	126-132
	- Year of Intake	1995	4	133-136
	- Radionuclide(s)	CS137	15	137-151
	- Committed Effective Dose Equivalent	35	7	152-158
	- Intakes Continued Elsewhere (Y/N)	N	1	159-159
13.	Shallow Dose Equivalent to the Skin	110	7	160-166
14.	Shallow Dose Equivalent to the Extremities			
	a. Forearms and Hands	223	7	167-173
	b. Lower Legs and Feet	146	7	174-180

ATTACHMENT 12.3

GUIDELINES GOVERNING LOSS ESTIMATION AND CRITERIA FOR DETERMINING PROPERTY VALUATION FOR FIRE AND NON-FIRE PROPERTY DAMAGE ACCIDENTS

1.0 COST ESTIMATING

a. Estimating accident costs for DOE facilities and programs is essential to categorize Type A, Type B, and other investigations. Cost estimation will be used to determine financial losses to the government, such as those due to fires, explosions, contamination accidents, and other property damage events. For serious accidents that result in property damage approaching $1 million or more, preliminary cost estimates must be made to ascertain if a Type B (>$1 million to <$2.5 million) or a Type A (>$2.5 million) investigation is required.

b. There are qualified people in DOE and/or contractor organizations who are trained and experienced in cost estimating. These individuals are required to follow the procedures in DOE Order 5700.2D, Cost Estimating, Analysis, and Standardization, which may include applying an appropriate cost index ratio (e.g., the producer price index) or data published in the periodical, ENR. This approach results in standardized cost estimates across DOE.

c. When estimating costs from accidents, personnel in cost estimating organizations should be involved. Initial cost estimates shall be developed as quickly as possible, but no later than 48 hours after the accident. These cost estimates shall be forwarded through the local DOE field organization to the Assistant Secretary for Environment, Safety and Health. Based upon the cost estimate, the appropriate type of investigation will be assigned.

d. The following sections provide guidance in two areas:

   (1) Criteria for determining the valuation of property; and

   (2) Criteria for determining losses based upon the value of property that is lost, destroyed, or otherwise impaired by an accident.

2.0 PROPERTY VALUATION

a. Property valuation includes the following:

   (1) The approximate replacement value of all DOE-owned buildings and DOE-owned or -operated equipment.

   (2) Estimated damage losses to government or private wetlands, grasslands, and forest as a result of DOE operations caused by fire or contamination.

   (3) Replacement cost for all DOE-owned supplies.

   (4) Average inventory of all source.

b. Property valuation excludes the following:

   (1) Land and land improvements, such as sidewalks and roads.

(2) Below ground facilities not susceptible to damage by fire or explosion, such as major water mains or irrigation ponds, that are carried as separate capital accounts.

3.0 LOSS ESTIMATION

a. Loss estimation includes the following:

(1) Damage or loss of facilities, inventories, and associated equipment as a result of an accident.

(2) All estimated or actual costs to restore DOE property to a reasonable approximation of pre-accident conditions, irrespective of whether or not this is done in fact. If an accident involves property that has been lost, completely destroyed, or contaminated to a degree precluding economically justifiable recovery, estimates shall be based on cost for actual replacement and installation of comparable equipment, devices, or materials.

(3) In the case of unused, obsolete, or excess building space, equipment, or materials that are not going to be replaced, the cost estimate of the market value at the time of accident shall be used.

(4) Estimated costs for restoring to a reasonable degree to pre-accident condition, without improvement, all partially lost or damaged DOE property. Where applicable, cost for decontamination operations should be included.

(5) Estimated costs for reprocessing and reclaiming partially destroyed and damaged materials. Where applicable, costs for damage resulting from firefighting (e.g., water and smoke damage) should be included.

(6) All post-incident cleanup expenses (e.g., cleanup of hazardous materials or radioactive contamination resulting from accidents, explosions, fires, or other incidents).

(7) All costs for recharging fire suppression systems (halon, carbon dioxide, and foam agent).

(8) Costs for damage caused by DOE operations to privately owned property.

(9) Costs for restoration of land and land improvements (i.e., sidewalks, roads, etc.) that were damaged as a result of an accident.

(10) Costs for outside specialists or organizations hired to mitigate losses and costs for non-standard labor hours (i.e., above the amount normally worked by the employee) for on-site personnel to restore the property to pre-accident condition.

(11) Any lost revenue experienced as a result of the accident. Examples include income-producing processes, such as power generating and transmission facilities, whose loss would cause a reduction in payments to the federal government.

b. Loss estimation excludes the following:

(1) Expenses resulting solely from loss of the use or occupancy of facilities affected by an accident, including lost production and research time, unless it becomes necessary to obtain special facilities (e.g., temporary structures) to maintain the facilities' use or occupancy.

(2) All post-accident expenses paid by non-DOE sources (e.g., expenses covered by private insurance).

(3) Expenses to bring property to modern standards.

(4) Normal wear.

(5) Damage to privately owned property not caused by DOE operations.

(6) Damage to land and land improvements (e.g., sidewalks, roads, etc.) from natural causes (e.g., freezing/thawing, earthquakes, floods, etc.).

(7) Labor hours for on-site firefighters during their normal workshifts.

(8) Labor hours expended by investigative and/or administrative personnel as a result of the incident.

(9) Theft (known or suspected) of DOE property.

4.0 MISCELLANEOUS LOSS ESTIMATION GUIDELINES

a. In general, loss estimates should be based upon the net cost for replacing or restoring damaged facilities, without improvement, to the condition existing prior to the accident regardless of whether or not the replacement or restoration of the damaged facility or facilities actually occurs.

b. Where the accident involves property that has been lost, completely destroyed, or contaminated to a degree precluding economically justifiable recovery, estimates should be based on the cost of actual replacement and installation of identical building equipment, devices, or materials.

c. Credit should be allowed for the estimated salvaged value of items recovered.

d. Expenses due to normal wear are not reportable losses when such wear is reasonably foreseeable. However, unanticipated loss is reportable. For example, the cost for repairing or replacing a tank with a leak caused by corrosion may not be an accidental loss; however, the cost for recovery and/or replacement of released material (including accompanying costs for product recovery, or replacement and costs for cleanup and decontamination) should be considered as accidental loss.

e. Burnout of electric motors and other electrical equipment through overheating from electrical causes shall be considered a "fire loss" only if self-sustained combustion exists after power is shut off.

ATTACHMENT 12.4

TABULATION OF WORK-HOURS, VEHICLE USAGE, AND PROPERTY VALUATION, DOE FORM 5484.4

DOE F 5484.4
(05-98)
All Other Editions
Are Obsolete

OMB Control No.
1910-0300

U.S. Department of Energy

Tabulation of Work-Hours and Vehicle Usage, and Property Valuation

OMB Burden Disclosure Statement

Public reporting burden for this collection of information is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Information Management, Program Management Group, Records Management Team, HR-424 - GTN, Paperwork Reduction Project (1910-0300). U.S. Department of Energy, 1000 Independence Ave., S.W., Washington, DC 20585; and to the Office of Management and Budget (OMB), Paperwork Reduction Project (1910-0300), Washington, DC 20503

Reporting Organization: ______________________ Calendar Year: __________

Organization Code: |_|_|_|_|_|_|_| Reporting Quarter: ❑ 1 ❑ 2 ❑ 3 ❑ 4

Revision: ❑ Yes ❑ No

PART A Tabulation of Work- Hours, and Vehicle Usage

A. Total Work- Hours this Quarter ______________________

DOE OR DOE - CONTRACTOR - OPERATED CONVEYANCES

Type of Vehicle		NUMBER OF VEHICLES	QUARTERLY USAGE: MILES OF TRAVEL	QUARTERLY USAGE: HOURS OPERATED
B. Cars, Light Trucks, Vans & Motorcycles				
C. Trucks (1 ton and over)				
D. Buses				
E. Aircraft	Fixed Wing			
	Rotary			
F. Marine				
G. Railroad				

Submitted by: ______________________

Telephone Number: ______________________

Date: ______________________

For CAIRS Use Only

Date Received: ______________________ CRT Input: __________

18 U.S.C. SECTION 1001; ACT OF JUNE 25, 1948; 62 STAT. 749; MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR PRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTERS WITHIN ITS JURISDICTION.

DOE F 5484.4
(05-98)
All Other Editions
Are Obsolete

OMB Control No.
1910-0300

PART B DOE ANNUAL ESTIMATED PROPERTY VALUATION

Field Organization: ______________________________

Revision: ______________________________ Date: __________

Reporting Organization	Organization Name	Replacement Valuation Beginning CY______ Previous Year ($1,000s)	CY______ Current Year ($1,000s)

Total Field Organization Valuation: ========================= =========================

Instructions for Completing DOE F 5484.4

PART A:
TABULATION OF WORK HOURS AND VEHICLE USAGE

The data submitted on Part A of this form are required for normalizing DOE accident statistics. Report all data at the end of each quarter, for that quarter only. Mail completed DOE F 5484.4 forms to the CAIRS Input Coordinator, SCIENTECH, Inc., 1690 International Way, Idaho Falls, Idaho 83402--Attention: CAIRS Input Coordinator. Revisions may be transmitted by facsimile (208-529-4721) or by mailing a copy of the revised original to the above address.

Item A - Include the hours worked for the quarter being reported. Do NOT report cumulative year-to-date totals.

Include all hours actually worked by all employees (salaried as well as hourly employees) for the quarter being reported. (**Do NOT report cumulative year-to-date totals.**) Work hours should include both scheduled hours and overtime. Work hours do not include vacation (annual leave), sick leave, holidays, administrative leave, or any other non-work time, even if employees are paid for it.

If the actual number is not available, you can estimate hours worked this way:

_______ **Find** the average number of full-time employees for your organization for the quarter.

X _______ **Multiply** by the number of work hours for a full-time employee in the quarter.

_______ This is the number of full-time hours worked during the quarter.

+ _______ **Add** the number of any overtime hours as well as the hours worked by other employees (part-time, temporary, seasonal) during the quarter.

(In each of the following categories, report the number of vehicles or air/marine craft which are assigned to, or under the charge of, the reporting organization at the close of the reporting period. Also report the total combined quarterly usage of all such vehicles in each category.)

Item B - Calculate use of cars, vans, light trucks (with less than a 1-ton rating), and motorcycles that are owned,leased, or rented by the Federal Government. Include data on privately owned vehicles of the same class if they are used in DOE contract work and for which cost reporting to DOE would be required in the event of accidental damage.

Item C - Calculate use of trucks (rated at 1 ton or greater) that are owned, leased, or rented by the Federal Government. Include data on privately owned trucks if used in DOE contract work and for which cost reporting to DOE would be required in the event of accidental damage.

Item D - Report use of buses owned, leased, or rented by the Federal Government to transport passengers and operated by professional drivers. Include usage data on privately owned buses used in DOE contract work and for which cost reporting to DOE would be required in the event of accidental damage.

Item E - Include data on aircraft, whether powered, towed, or free-flying, which are being operated by a DOE or DOE contractor employee. This includes privately owned aircraft, as well as Federal Government-owned, -leased or -rented aircraft. Count only airborne operation hours.

Item F - Include usage data on waterborne craft, e.g., motorized, nonmotorized, steam, sail, towed, operated by a DOE or DOE contractor employee. This includes privately owned craft as well as Federal Government-owned, -leased, or -rented marine craft.

Item G - Railroad: Include data usage on any unit of equipment (or combination) listed below, operated by a DOE or DOE contractor employee: Count each unit or car as a single vehicle, and only the miles traveled by the power unit:

<u>Locomotive</u>: self-propelled unit of equipment designed solely for moving other equipment

<u>Light Locomotive</u>: self-propelled unit of equipment not coupled to any other equipment

<u>Motor Car</u>: self-propelled unit of equipment designed to carry freight or passengers (not a locomotive)

<u>Cars</u>: examples include freight, passenger, dining, equipment, caboose, chemical, gondola, mining, ATMX, courier

PART B:
DOE ANNUAL ESTIMATED PROPERTY VALUATION

The data submitted on Part B of this form are required to estimate replacement value of all DOE owned property under the reporting organization's jurisdiction.

Copies of this form will be supplied to all reporting units at the beginning of each calendar year. The previous year's valuation, as reported to CAIRS , is reprinted to provide comparative figures for the current year's input. Mail completed forms to the CAIRS Input Coordinator, SCIENTECH, Inc., 1690 International Way, Idaho Falls, Idaho 83402-- Attention: CAIRS. Revisions may be transmitted by facsimile (208-529-4721) or by mailing a copy of the revised original to the above address.

APPENDIX D
TRANSMITTAL OF INDIVIDUAL ACCIDENT/INCIDENT REPORTS
(EXAMPLE)

Reporting Organization:____

Organization Code
Number:____

Date of Transmittal:
____

Number of New Accident/Incident Reports Included in
Transmittal:_____________________________
(List by case number each report included in transmittal)

____________ ____________ ____________
____________ ____________ ____________ ____________
____________ ____________ ____________ ____________
____________ ____________ ____________ ____________
____________ ____________ ____________ ____________
____________ ____________ ____________ ____________
____

Number of Revised Accident/Incident Reports Included in
Transmittal:______________________
(List by case number each report included in transmittal)

____________ ____________ ____________ ____________
____________ ____________ ____________ ____________
____________ ____________ ____________ ____________

Contact Person:

Name: ____

Phone Number: ____

Address:____

ANNUAL SUMMARY OF FIRE DAMAGE EXPERIENCE REPORT FOR CALENDAR YEAR _______

1. FIRE-RELATED DEATHS AND INJURIES.

   Describe each incident relating to death or injury by fire.

2. DOE PROPERTY LOSS EXPERIENCE FOR THE CALENDAR YEAR

   Fire Loss $___________

   Other Loss $___________

   a. Fire loss includes damage or loss sustained as a consequence of and following the outbreak of fire. The test for whether or not a fire loss is reportable is based upon the fire department incident report. If the occurrence results in a dispatch and fire department response, then the loss is considered in the "Fire Loss" category. If a fire department incident report was not generated, or the report relates to a non-fire event, then the loss is considered a part of the "Other Loss" category. Exceptions are:

      (1) Burnout of electric motors and other electrical equipment through overheating is considered a fire loss only if self-sustained combustion exists after power is shut off.

      (2) Vehicle losses (including aircraft, marine, and railroad equipment) are considered a fire incident if the loss was sustained as a direct consequence of fire. All losses, including fire, that involve cargo during transport are treated as transportation losses. Fire department incident reports will specifically identify these incidents.

   b. Other Loss includes damage or loss sustained as a consequence of the following events:

      (1) Explosions

      (2) Natural disasters (such as earthquakes and hurricanes)

      (3) Electrical malfunctions

      (4) Transportation (cargo) losses

      (5) Mechanical malfunctions

      (6) Radiation releases or other nuclear accidents

(7) Miscellaneous accidents (such as thermal-, chemical- or corrosion-related accidents)—These other events may not be associated with a corresponding fire department incident report.

3. SUMMARY OF FIRE DAMAGE INCIDENTS

a. Describe each fire incident that results in a loss estimate over $5,000. Description should be taken from the fire department incident report.

b. Incidents for which the estimated loss is below the $5,000 threshold should be summarized and reported at the end of the calendar year in conjunction with the development of the annual summary.

c. For each incident, identify the property loss as defined in Paragraph 2, above, and provide the fire incident report number. (Refer to NFPA 902M, "Fire Reporting Field Incident Manual.")

4. INCIDENTS ACTUATING AUTOMATIC FIRE SUPPRESSION SYSTEMS

a Describe each incident involving the actuation of an automatic fire suppression system. Include the loss amount, type of system, number of sprinkler heads activated, quantity of agent discharged, and remedial actions taken to prevent future accidental discharges if applicable.

b. Include a causative factor description in the summary according to fire or "other" category headings, with the latter sub-categorized as follows:

(1) Electrical

(2) Mechanical

(3) Human Error

(4) Acts of Nature

(5) Miscellaneous

5. HALON REDUCTION ACTIVITIES

a. Halon 1301

(1) Number of fixed systems ______

(2) Total quantity (lbs.) of Halon 1301 at site

(a) Active (include reserve) ______

(b) Inventoried ______

(3) Number of fixed systems and system quantity deactivated within the past year _____ _____

(4) Number of fixed systems and system quantity converted to manual operation within the past year _____ _____

b. Halon 1211

(1) Total quantity (lbs.) of Halon 1211 at site

(a) Active ______

(b) Inventoried ______

(2) Quantity replaced by other agents within the past year _______

6. FIRE PROTECTION INSPECTION TESTING AND MAINTENANCE ACTIVITIES

a. System Type

(1) Number Inspected, Tested, or Maintained.

(2) Number failing to meet operability requirements.

Not Operable ______ Number Requirement ______

Description Failed

b. All failures of fire protection systems (sprinkler systems, fire alarm systems, etc.) should be reported annually. "Failure" in this context is the inability to meet at least one of the "Operability Requirements" established for the system as part of the inspection, testing, and maintenance program. (Refer to DOE Order 420.1, Facility Safety.) Summaries should be provided for each system type at the site. System types are:

- Wet Pipe Sprinkler System
- Dry Pipe Sprinkler System
- Deluge Sprinkler System
- Pre-Action Sprinkler System (with supervisory air)
- Pre-Action Sprinkler System
- Foam-Water Extinguishing System
- Wet Standpipe System
- Dry-Standpipe System
- Manual Water Spray System
- Halon 1301 (total flooding)
- Halon 1211 (total flooding)

- Dry Chemical System
- Wet Chemical System
- High Expansion Foam System
- Carbon Dioxide Extinguishing System (high pressure)
- Carbon Dioxide Extinguishing System (low pressure)
- Water Spray System (local application)
- Special Extinguishing System
- Pond or Lake Water Supply
- Tank Water Supply System
- Fire Pumps
- Fire Service Mains
- Fire Alarm Systems
- Central Monitoring (fire system)
- Fire Doors and Windows
- Fire Dampers
- Fire Wall Integrity
- Emergency and Exit Illumination

7. FIRE DEPARTMENT ACTIVITIES

a. Number of Responses

(1) Fire ____

(2) HAZMAT Response ____

(3) Other Emergency ____

(4) Non-Emergency ____

(5) Medical ____

Identify and classify all fire department response events. Each response should be recorded in a single fire department incident report from the first due or incident commander's perspective. Supplemental reports or responses should not be included in this report.

The "fire" response category relates to working fires on the site that were either extinguished or verified as a fire event by the responding incident commander. HAZMAT response relates to non-fire hazardous material incidents. The "other emergency" category is intended for all other emergencies in which firefighting apparatus was dispatched, including off-site mutual aid response or support for a medical response. The "non-emergency" category relates to situations where the initial response was considered an emergency, but was later verified as a non-emergency by the incident commander. This includes inadvertent system actuation, malicious alarms, or off-site mutual aid that was canceled enroute. Medical response includes any response in which an ambulance was dispatched for the sole purpose of a medical emergency.

b. Major Equipment Purchases.

Describe type of equipment and purchase price.

(1) Emergency Vehicle ____

____

____

(2) Other ____

____

____

c. Address notable response descriptions not already included this report.

8. RECURRING FIRE PROTECTION PROGRAM COSTS.

Include figures on the present and past two years:

a. Fire Department Costs:

(1) Staffing _____ _____ _____

(2) Equipment _____ _____ _____

(3) Inspection & Testing Program Costs _____ _____ _____

(4) Emergency Medical Response Program Costs _____ _____ _____

(5) Training Program Costs _____ _____ _____

b. Inspection and testing program costs by others _____ _____ _____

c. Fire protection engineering _____ _____ _____

d. The cost in Paragraph b, above, is intended to identify work provided by other departments, such as a maintenance division or outside contractor. Do not include costs for mobile apparatus or other major equipment purchases. Provide additional explanation for significant deviations in recurring costs between calendar years.

ATTACHMENT 12.6

INDIVIDUAL OCCUPATIONAL EXPOSURE REPORT,
DOE FORM 5480.7

OMB Control No.
1910-0300
Privacy Act Statement
on Reverse

OMB Burden Disclosure Statement

Public reporting burden for this collection of information is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Information Management, Program Management Group, Records Management Team, HR-424 - GTN, Paperwork Reduction Project (1910-0300), U.S. Department of Energy, 1000 Independence Ave., S.W., Washington, DC 20585; and to the Office of Management and Budget (OMB), Paperwork Reduction Project (1910--0300), Washington, DC 20503.

U.S. DEPARTMENT OF ENERGY

INDIVIDUAL OCCUPATIONAL EXPOSURE REPORT

1. Name (Last, First, Middle Initial)

2. Identification Number

3. Date of Birth

4. Sex
- ☐ Male
- ☐ Female

5. Monitoring Period

6. Site or Facility Name

7. Monitoring Status
- ☐ General Employee
- ☐ Terminated Employee
- ☐ Embryo/Fetus
- ☐ Member of the Public
- ☐ Minor
- ☐ Other

8. Report Type
- ☐ Requested
- ☐ Annual
- ☐ Termination

9. Dose Data
- ☐ Recorded
- ☐ Estimated

10. Monitoring Type
- ☐ Routine
- ☐ PSE
- ☐ Emergency

11. Comments

RADIOLOGICAL DOSE (in mrem)

Internal: 12. Committed Effective Dose Equivalent ______________

Intake

13a. Radionuclide	13b. Quantity (microcurie)

Ogran or Tissue Committed Dose Equivalent (CDE)

14a. Organ/Tissue	14b. CDE

External:

15. Effective Dose Equivalent ______________
16. Lens of the Eye Dose Equivalent ______________
17. Shallow Dose Equivalent to the Skin ______________
18. Shallow Dose Equivalent to Max Extremity ______________

Summation of Internal and External Doses:

19. Total Effective Dose Equivalent ______________

Ogran or Tissue Committed Dose Equivalent (CDE)

20a. Organ/Tissue	20b. TODE

21. Cumulative Total Effective Dose Equivalent ______________

Declared Pregnant Worker:

22. Embryo/Fetus Dose Equivalent ______________

23. Signature

24. Date Prepared

Privacy Act Statement

This form is to be used for providing radiation exposure monitoring results to an individual who visited or performed work at a DOE or DOE contractor site or facility, and its use is subject to the provisions of the Privacy Act of 1974, 5 U.S.C. 552a. The authority to collect the information provided is derived from 5 U.S.C. 301; this authority incorporated by reference in Title III of the Department of Energy Organization Act at 42 U.S.C. 7151, including 42 U.S.C. 2201 and 42 U.S.C. 5813 and 5817. This information may be disclosed to the U.S. Navy, Nuclear Regulatory Commission, DOE contractors and consultants, and other organizations for the purpose of monitoring radiation exposure; to the Department of Health and Human Services or its components to facilitate health hazard evaluations or epidemiological studies; to certain individuals in the performance of health studies or related activities; or to certain advisory committees providing advice to DOE regarding health, safety and environmental issues pursuant to a routine use authorized by the system of records DOE-35, "Personnel Radiation Exposure Records."

Instructions and Additional Information Pertinent to the Completion of DOE F 5480.7

(All doses should be stated in mrem)

1. Type or print the full name of the monitored individual in the order of the last name (include "Jr.", "Sr.", "III", etc.), first name, and middle initial (if applicable).

2. Enter the individual's social security number. If the individual has no social security number, enter the individual's employee number.

3. Enter the date of birth of the individual being monitored in the format MM/DD/YY.

4. Check the box that denotes the sex of the individual being monitored.

5. Enter the monitoring period for which this report is filed in the format MM/DD/YY - MM/DD/YY. If the dose report is for the embryo/fetus, enter the estimated date of conception and the end of the monitoring period.

6. Enter the site or facility name.

7. Place an "X" in the appropriate box for the employment status of the individual. Choose "General Employee" if the individual meets the requirements of a general employee or is visiting a site for the purpose of performing scientific research. Choose "Member of the Public" if the individual is visiting the site or facility and is monitored. Choose "Terminated Employee" if the individual is no longer an employee and was monitored during this period. Choose "Minor" if the individual visiting the site is less than 18 years of age and is monitored. Choose "Embryo/Fetus" if reporting the dose for an embryo/fetus. Choose "Other" if the individual is a DOE Headquarters employee, DNPSB employee, or related contractor.

8. Place an "X" in the appropriate box for the type of report being filed. Choose "Requested" if the individual requested the information. Choose "Annual" if the report being filed is the annual radiation dose summary. Choose "Termination" if the report being filed is a termination report.

9. Place an "X" in the appropriate box for the dose data being filed. Choose "Record" if the dose data listed represents a final determination of the dose received to the best of the site's knowledge. Choose "Estimate" only if the listed dose data are preliminary and will be superseded by a final determination resulting in a subsequent report.

10. Place an "X" in the appropriate box for the type of monitoring. Choose "Routine" if the data represent the results of monitoring for routine exposures. Choose "PSE" if the listed dose data represent the results of monitoring of planned special exposures received during the monitoring period. If more than one PSE was received in a single year, the contractor should sum them and report the total of all PSEs. Choose "Emergency" if the dose data represent results of monitoring for exposures received during an emergency.

11. In the space provided for comments, enter any additional information that might be needed to determine compliance with limits.

12. Enter the committed effective dose equivalent (CEDE) or "MNR" for "Monitoring Not Required" or "NC" for "Not Calculated."

13a. Enter the symbol for each radionuclide that resulted in an internal exposure for the individual, using the format Xx-###.

13b. Enter the intake quantity for each radionuclide in microcurie.

14a. Enter each organ or tissue that received a dose resulting from intakes of radioactive material.

14b. Enter the committed dose equivalent (CDE) for each organ or tissue.

15. Enter the effective dose equivalent for the whole body; deep dose equivalent may be used.

16. Enter the lense of the eye dose equivalent.

17. Enter the shallow dose equivalent to the skin.

18. Enter the shallow dose equivalent for the skin of the extremity receiving the maximum dose. This dose equivalent must be greater than or equal to the effective dose equivalent for the whole body.

19. Enter the total effective dose equivalent (TEDE) for the individual. The TEDE is the sum of the committed effective dose equivalent (12) and the effective dose equivalent (15).

20a. Enter each organ or tissue that received a dose caused from intakes of radioactive material.

20b. Enter the total organ dose equivalent (TODE) for each organ or tissue. The TODE is the sum of the committed dose equivalent to the organ (14b) and the deep dose equivalent (15).

21. Enter the cumulative total effective dose equivalent (CTEDE) for this individual.

22. Enter the dose equivalent to the embryo/fetus for a declared pregnant worker.

23. Signature of the person designated to represent the Department or DOE contractor.

24. Enter the date this form was prepared.

ATTACHMENT 12.7

INSTRUCTIONS FOR PREPARING OCCUPATIONAL EXPOSURE DATA SUMMARIES

APPENDIX G
INSTRUCTIONS FOR PREPARING OCCUPATIONAL EXPOSURE DATA SUMMARIES
(CONTINUED)

1. Radiation exposure data summaries submitted to the Radiation Records Repository shall be as follows:

   a. Individual exposure data records are to compose an unlabeled ASCII file with one record per block.

   b. Each exposure data record is to be of a fixed length containing exactly 180 characters, blank padded when necessary. Do not use nulls (ASCII character 0) in any record. Terminate each record with a carriage return (ASCII character 13).

   c. The exposure data file is to be error checked using the REMEDIT program (available from the Repository) and all reported errors resolved prior to transmitting the file to the Radiation Records Repository.

   d. Submit the exposure data file to the Repository on an IBM compatible 3.5" diskette, 1.44 MB formatted capacity.

2. Radiation exposure data to be sent to the employer of a visiting DOE contractor employee may be provided as a radiation exposure report.

3. The "Occupational Exposure Data Summary" and "Occupational Exposure Data Summary Explanation" describe each exposure record's format and content.

OCCUPATIONAL EXPOSURE DATA SUMMARY

4. The field size and column range specified are values required for use in formatting each record. Responses are required to items 1 through 11. Responses to items 12 through 14 are required where applicable.

5. All dose equivalents shall be in units of millirem, rounded to the nearest whole number and right justified within the appropriate field. A blank dose field indicates specific monitoring was not conducted. Zero dose represents a "less than measurable" exposure.

6. Individual exposure data records required to be reported to the Radiation Records Repository shall be formatted as follows:

Item	Example Code or Data	Field Size (Characters)	Column Range
1. Calendar Year	1995	4	1-4
2. Social Security Number	123456789	9	5-13
3. Name			
a. First Name or Initial	JOHN	15	14-28
b. Middle Name or Initial	Q	12	29-40
c. Last Name	DOE	15	41-55
4. Birth Year	1942	4	56-59
5. Sex	M	1	60-60
6. Begin Monitoring Date	010195	6	61-66
7. End Monitoring Date	123195	6	67-72
8. Monitoring Status	G	1	73-73
9. Organization Code	0567002	7	74-80
10. Facility Type Code	21	2	81-82
11. Occupation Code	184	3	83-85
12. Whole Body Dose			
a. Total Effective Dose Equivalent	112	7	86-92
b. Deep Dose Equivalent			
- Including Neutron	100	7	93-99
- Neutron Only	20	7	100-106
c. Internal Dose			
- Year of Intake	1995	4	107-110
- Radionuclide(s)	AM241	15	111-125
- Committed Effective Dose Equivalent	12	7	126-132
- Year of Intake	1995	4	133-136
- Radionuclide(s)	CS137	15	137-151
- Committed Effective Dose Equivalent	35	7	152-158
- Intakes Continued Elsewhere (Y/N)	N	1	159-159
13. Shallow Dose Equivalent to the Skin	110	7	160-166
14. Shallow Dose Equivalent to the Extremities			
a. Forearms and Hands	223	7	167-173
b. Lower Legs and Feet	146	7	174-180

OCCUPATIONAL EXPOSURE DATA SUMMARY EXPLANATION

1. CALENDAR YEAR - Enter the calendar year for which data are being submitted. A site dosimetry record year may differ slightly from the actual calendar year due to dosimeter processing schedules. Minor variances (up to 2 weeks before or after January 1) are permissible as long as the reporting period is consistent from year to year.

2. SOCIAL SECURITY NUMBER - Enter the individual's social security number. If none, enter the individual's employee, passport, or visa number preceded by an "X" and left justified; truncated as necessary.

3. NAME - Enter the name of the monitored individual as it appears on company payroll records for a site employee; or as on a driver's license, passport, visa, or other valid form of identification for a visiting individual.

   a. FIRST NAME OR INITIAL - Enter the first name or initial in upper case and left justified.

   b. MIDDLE NAME OR INITIAL - Enter the middle name or initial in upper case and left justified.

   c. LAST NAME - Enter the last name in upper case and left justified.

4. BIRTH YEAR - Enter the year of birth in the format YYYY.

5. SEX - Enter "F" for female or "M" for male.

6. BEGIN MONITORING DATE - Enter the earliest date monitoring began in the format MMDDYY (month-day-year).

7. END MONITORING DATE - Enter the latest date monitoring ended in the format MMDDYY. If the monitoring period of a visiting individual bridges 2 calendar years (see Item 1, above) and the individual is provided a single dosimeter for the duration of the visit, the exposure results are to be reported for the year the dosimeter is processed. However, if a visiting individual is provided a separate dosimeter in each calendar year, a separate report is required for each year.

8. MONITORING STATUS - Enter the 1-digit code for the monitoring status.

   - GENERAL EMPLOYEE: Enter "E" for an individual employed by the reporting organization as of the close of the calendar year (see Item 1, above), a visiting research scientist, or a student.

   - MEMBER OF THE PUBLIC: Enter "P" for a member of the public (which would include a visiting dignitary) who visited during the calendar year.

- GOVERNMENT: Enter "G" for an individual who is a DOE employee, DNFSB employee or contractor, a DOE Headquarters or Field office support contractor, IAEA inspector, etc.

- TERMINATED EMPLOYEE: Enter "T" for an individual no longer employed by DOE or a DOE contractor, an individual who transfers his or her employment to another DOE or DOE contractor facility or office that results in termination of radiological monitoring, an individual who begins a leave of absence of greater than 12 months duration, or an employee of a contractor whose contract with DOE has been terminated and the employee has not been hired by another DOE contractor.

9. ORGANIZATION CODE - Enter the employer's organization code. For a member of the public or a visiting research scientist, enter the organization code of the reporting host. Organization codes shall be obtained from the Radiation Records Repository.

10. FACILITY TYPE CODE - Enter the code from Table 1 of this appendix for the facility contributing the predominant portion of the individual's total effective dose equivalent. Otherwise, indicate the facility wherein the greater portion of work service was performed.

11. OCCUPATION CODE - Enter the code from Table 2 of this appendix for the generic occupation that best fits the individual's occupational title. Do not enter a code for a member of the public or a visiting research scientist.

12. WHOLE BODY DOSE - Enter the appropriate dose equivalent in units of millirem, right justified. Do not include any occupational dose received by the individual during an off-site visit.

    a. TOTAL EFFECTIVE DOSE EQUIVALENT - Enter the sum of the deep dose equivalent and the total committed effective dose equivalent.

    b. DEEP DOSE EQUIVALENT - Enter the deep dose equivalent (i.e., the effective dose equivalent to the whole body, nominally at 1.0 cm depth, from external radiation sources).

        - Including Neutron.

        - Neutron only.

    c. INTERNAL DOSE - Enter the committed effective dose equivalent due to internal uptakes received during the calendar year monitoring was conducted.

- Year of intake.

- Radionuclide(s) - Enter the radionuclides that contributed the predominant internal dose (3 radionuclides maximum - no daughter products).

- Committed effective dose equivalent.

- Year of intake.

- Radionuclide(s) - Enter the radionuclides that contributed to the internal dose (3 radionuclides maximum - no daughter products).

- Committed effective dose equivalent.

- Uptakes continued elsewhere - Enter "Y" for Yes or "N" for No. Submit a separate exposure report if an individual's total committed effective dose equivalent is due to 7 or more parent radionuclides.

13. SHALLOW DOSE EQUIVALENT TO THE SKIN - Enter the shallow dose equivalent at 0.007 cm depth in units of millirem, right justified (add any neutron dose component reported for deep dose equivalent).

14. SHALLOW DOSE EQUIVALENT TO THE EXTREMITIES - Enter the shallow dose equivalent in units of millirem, right justified. When both left and right extremities were monitored, record the higher of the right or left dose equivalent. When both extremity and whole body dosimeters were used during a monitoring period, do not add the whole body shallow dose to the extremity dose. During periods when extremity monitoring was occasionally conducted, enter the sum of all extremity dose components and the shallow dose equivalent measured during the period(s) when extremity dosimetry was not worn. In all cases, add any neutron dose component reported for deep dose equivalent.

    a. FOREARMS AND HANDS - Enter the dose equivalent for the arm below the elbow.

    b. LOWER LEGS AND FEET - Enter the dose equivalent for the leg below the knee.

Table 1
FACILITY TYPE CODES

CODE	FACILITY TYPE OR OPERATION[1]
10	Accelerator
21	Fuel/Uranium Enrichment
22	Fuel Fabrication
23	Fuel Processing
40	Maintenance and Support (site-wide)
50	Reactor
61	Research, General
62	Research, Fusion
70	Waste Processing/Management
80	Weapons Fabrication and Testing
99	Other

(1) Workers should be assigned to one facility type where the predominant amount of the individual's work takes place.

Table 2
OCCUPATIONAL CODES

DOE CODE	DOE OCCUPATIONAL CATEGORIES	CROSS-REFERENCE SOC CODE (ranges)[1]
001	UNKNOWN	
110	MANAGERS AND ADMINISTRATORS	11 - 14
-	PROFESSIONAL	15 - 39
160	Engineers	16
170	Scientists	17 - 19
184	Health Physicists	1843
200	Miscellaneous Professionals	20 - 25, 32 - 34
260	Doctors and Nurses	26 - 30
350	Technicians	35 - 39
360	Health Technicians	36
370	Engineering Technicians	37
380	Science Technicians	38
383	Radiation Monitors/Technicians	383
390	Miscellaneous Technicians	39
400	SALES	40 - 44
450	ADMINISTRATIVE SUPPORT AND CLERICAL	45 - 47
-	SERVICE WORKERS	50 - 52
512	Fire fighters	512
513	Security Guards	513/4
521	Food Service Employees	521
524	Janitors	524
525	Miscellaneous Service Employees	523, 525/6

Table 2
OCCUPATIONAL CODES

DOE CODE	DOE OCCUPATIONAL CATEGORIES	CROSS-REFERENCE SOC CODE (ranges)[(1)]
-	AGRICULTURAL WORKERS	55 - 58
562	Grounds keepers	562
570	Forest Workers	57
580	Miscellaneous Agricultural Workers	55, 561, 58
-	REPAIR/CONSTRUCTION WORKERS	60 - 65
610	Mechanics/Repairers	60 - 61
641	Masons	641
642	Carpenters	642
643	Electricians	643
644	Painters	644
645	Pipe Fitters	645
650	Miners/Drillers	65
660	Miscellaneous Repairers/Construction Workers	63, 646
-	PRECISION/PRODUCTION WORKERS	67 - 78
681	Machinists	681
682	Sheet Metal Workers	682
690	Operators, Plant/System/Utility	69
710	Machine Setup/Operators	71 - 76
771	Welders and Solderers	771
780	Miscellaneous Precision/Production Workers	67, 683 - 88, 722 - 78
-	TRANSPORT WORKERS	81 - 83
820	Truck Drivers	8212 - 8214
821	Bus Drivers	8215
825	Pilots	825
830	Equipment Operators	83
840	Miscellaneous Transporters	81, 8216 - 824, 828
850	HANDLERS/LABORERS/HELPERS	85 - 87
910	MILITARY PERSONNEL	91
990	MISCELLANEOUS WORKERS	99

(1) Refers to the Department of Commerce's Standard Occupational Classification (SOC) Manual (1980).

SECURITY

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the methods and responsibilities for maintaining site security required by DOE Notice 473.6.

2.0 REFERENCES

2.1 DOE Notice 231.1, 9/18/00

2.2 DOE Notice 251.40, 5/3/01

2.3 Presidential Decision Directive 39 on U.S. Policy on Counterterrorism, June 21, 1995

2.4 Exemption Request Procedures for Authorization of Low-Level Radioactive Waste (LLW) and Mixed Low-Level Radioactive Waste (MLLW) Shipments, Office of Integration and Disposition

2.5 Approval of Commercial Shipments of Radioactive Materials and Waste on Behalf of the Office of Environmental Environment

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3.0 DEFINITIONS

3.1 SECON-5

This security condition (SECON) exists when a general threat of possible terrorist activity exists, but warrants only routine security measures associated with daily operations. Requires normal operating condition.

~~1.2~~3.2 SECON-4

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This security condition applies to a possible threat of terrorist activities and generally enhances security awareness responsibilities. There is an increased general threat of possible malevolent or terrorist activity against personnel and facilities, the nature and extent of which are unpredictable, and circumstances do not justify full implementation of SECON-3 measures. It may be necessary, however, to implement certain selected measures from higher SECONs to address intelligence received or to act as a deterrent. All measures selected for use under SECON-4 must be capable of being maintained indefinitely.

~~1.3~~3.3 SECON-3

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This security condition is used when an increased and more predictable threat of terrorist activity exists and may increase access controls to include additional personnel and vehicle barriers. The measures in this SECON must be capable of being maintained for weeks without causing undue hardship, affecting operational capability, or aggravating relations with the local community. In addition to the measures required by SECON-4, SECON-3 measures should be implemented.

~~1.4~~3.4 SECON-2

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This security condition is set when a terrorist incident occurs or intelligence information is received indicating that some form of terrorist action is imminent, and requires specific protection measures to be put in place. Intelligence is received indicating that some form of malevolent or terrorist action against personnel and facilities is imminent. Implementation of measures in this SECON for more than a short period probably will create hardship and affect the routine activities of the site and its personnel.

~~1.5~~3.5 SECON-1

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This is the most serious security condition declared in the immediate area where a terrorist attack has occurred which may effect the site or when an attack is initiated on the site. It significantly increases protective measures and may require additional protective elements along with those in SECON-2. Implementing this SECON will create hardship and affect the activities of the site and its personnel. Normally, this SECON is declared as a localized condition.

4.0 RESPONSIBILITIES

4.1 Project Manager

The Project Manager (PM) is responsible for ensuring that all applicable SECON measures are implemented at the site in a timely manner after receipt of notification of applicable SECON.

~~1.2~~4.2 Waste Coordinator

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The Waste Coordinator (WC) is responsible for ensuring that security measures applicable to waste storage, handling, and shipping activities are implemented.

~~1.3~~4.3 Site Records Administrator

The Site Records Administrator (SRA) is responsible for inspecting incoming mail and packages.

~~1.4~~4.4 Site Health and Safety Officer

The Site Health and Safety Officer is responsible for informing the site staff of applicable and appropriate security measures.

~~1.5~~4.5 Delegation

Responsibilities may delegated, but delegations must be documented. The PM is responsible for ensuring the person to whom the work is delegated has qualifications commensurate with the responsibilities being assigned.

5.0 APPLICABLITY

This SOP applies to all work performed at LEHR and the Cobalt-60 Irradiator Facility. ~~Until further notice, this procedure applies to shipments of LLW and MLLW only.~~

6.0 SECURITY MEASURES

6.1 SECON-5

Normal site operations will continue. No additional security measures are required.

~~1.2~~6.2 SECON-4

[Reserved]

~~1.3~~6.3 SECON-3

[Reserved]

~~1.4~~6.4 SECON-2

[Reserved]

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~~1.5~~6.5 Requirements for Shipment of Placarded Low-Level ~~Radioactive Waste or~~and Mixed Low-Level Radioactive Waste, Transuranic Wastes and Type A Quantities of Radioactive Materials from Environmental Management Operations

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Additional requirements shall be implemented in accordance with directives provided by the DOE Office of Integration and Disposition (OID) or other DOE department(s). Under SECON-3 and SECON-2, a suspension of LLW and MLLW shipments may be imposed. The OID has developed procedures for granting exceptions to such suspension. In order to obtain an exemption from an order requiring suspension of all LLW or MLLW, an exemption form (Attachment 8.2) must be completed, signed and approved by the DOE Headquarters (HQ) Office and the OID. The PM will ensure that the exemption request form is completed, will sign the form and provide it to the DOE PM for HQ approval.

To obtain approval of the exemption request, the PM will certify that the following actions have been completed or will be completed prior to shipment, as required by OID:

- Verify and document that site security plans require drivers entering the facility for loading/unloading of shipments to sign in at the security gate [brown trailer?] and be escorted to the loading/unloading location unless a security badge has been issued.
- Verify and document the name of the drivers to be used for commercial shipments are on the list provided by the motor carrier that identifies drivers who will be entering DOE facilities to pick up shipments.
- Verify and document the motor carriers to be used have provided documentation that all drivers meet the personnel security requirements addressed in the Department of Transportation's Security Sensitive Visits.
- Obtain copies of documentation from the carriers that all drivers are citizens of the United States.
- Verify the drivers have a Commercial Driver's License with proper hazardous materials endorsement and attach a copy to the shipment documentation to be kept on file for each shipment.
- Verify and document the carriers utilize satellite tracking and/or maintains cellular telephone contact during the requirement that the driver must contact carrier dispatch at regular intervals.
- Require security staff to perform and document pre-loading equipment inspections to avoid explosive and other devices as detailed in Measure 18 of DOE Notice 473.6, Security Conditions (Section 6.5.1 below).
- Provide the drivers a briefing and a copy of written instructions regarding en route shipment security measures to be taken. Ensure the drivers can read and understand the instructions provided and have the driver sign a copy of the instructions. Attach signed and dated copy of the instructions to the shipment documentation to be kept on file.

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- Request consignee notification of receipt of shipments.
- ~~The WC has obtained a list of the drivers that will be entering the LEHR facilities prior to the pickup of the shipment.~~
- ~~The WC has verified that each driver is a citizen of the United States. This may be done by obtaining a signed statement from the carrier certifying that all drivers assigned to the LEHR site are United States (US) citizens. Alternatively, the WC shall obtain the US passport or a combination of a birth certificate and driver's license from each driver and verify that they are US citizens.~~
- ~~The WC has obtained a copy of each driver's commercial drivers license (CDL) with proper hazardous materials endorsement. The WC has matched the CDL to the driver and to the list of drivers supplied by the carrier.~~
- ~~The WC has conducted safety/security inspections of all incoming and outgoing shipments, in accordance with Section 6.5.1 of this SOP.~~
- ~~The WC has verified that all vehicles are equipped with tracking (e.g. Qualcomm) and/or voice communication (e.g. cell phones) hardware. The WC has instructed the driver to demonstrate that the tracking system is operational.~~

After the completed exemption request has been approved by DOE HQ, the PM will forward the signed request to the OID for approval. The form will be provided to Beverly Cook via fax at (301) 903-1398.

Additional information regarding the exemption request approval process may be obtained from the following contacts at the OID:

- Josh Williams (301) 903-7179
- Karen Guevara (301) 903-4981
- Michael Conroy (301) 903-2728
- Tracy Mustin (301) 903-4688

6.5.1 Inspections

When required by the OID or other DOE department(s), the WC will inspect all trucks used for shipping LLW or MLLW waste from the site to a treatment, storage, and/or disposal facility. Shipments of sample quantities are exempt from this requirement. The inspection will be conducted visually with the objective of identifying suspect conditions, including but not limited to the presence of explosives and incendiary, biological, or chemical devices.

The inspection will be conducted as close in time as possible to the departure of the truck from the departure location. The inspection will include:

- Visual observation of the truck cabin for suspect items (such as clock mechanisms, wires, powders, suspicious packages, gas cylinders, respirators, etc.);

- Verification that all locking mechanisms on the truck are operational;
- Inspection of the undercarriage for suspect items;
- Inspection of all cargo compartments;
- Inspection of engine compartment;
- Inspection of all locked compartments; and,
- Inspection of vehicle for suspect odors.

In addition, the WC will ask the driver the questions listed in Attachment 8.1. If the WC finds that the driver cannot satisfactorily answer the questions and/or there is cause for suspicion, the WC shall immediately contact the PM for additional guidance. If the WC suspects any illegal activity or the presence of contraband, the WC will immediately contact the UC Davis Police Department and the PM for further instructions.

7.0 RECORDS

The SRA will control and maintain records generated as a result of this SOP in the project record files in accordance with Standard Quality Procedure 4.2, Records Management.

8.0 ATTACHMENTS

8.1 Vehicle Security Check Form

8.2 Exemption Request for Low-Level Radioactive Waste or Mixed Low-Level Radioactive Waste Shipments

ATTACHMENT 8.1

VEHICLE SECURITY CHECK FORM

VEHICLE SECURITY CHECK

Driver Name: ____________________

Vehicle License Number: ____________________

Date: ____________________

Security Check Performed By: ____________________

The driver of the vehicle should be asked the following questions:

Has the vehicle been under the driver's control since leaving the carrier's facilities?	Yes	No
Has the vehicle been locked when the driver is away from the vehicle?	Yes	No
Has the driver accepted any packages or materials for transport prior to arriving at LEHR?	Yes	No
Has the required security inspection of the vehicle been performed?	Yes	No
Is the voice communication or tracking system operational?	Yes	No

Document Verification

Verify that the identity of the driver matches the documentation provided.	Yes	No
Is the driver's name on the list of drivers provided by the carrier?	Yes	No

Additional Comments:

____

____

____

____

____

____

ATTACHMENT 8.2

EXEMPTION REQUEST FOR LOW-LEVEL RADIOACTIVE WASTE OR MIXED LOW-LEVEL RADIOACTIVE WASTE SHIPMENTS

We are requesting an exemption to make the following shipments for the weekly period noted:

Shipping Site	Material	Mode	Receiving Site	Number of Shipments	Container/ Package (IP, A, B, etc.)	Volume	Units

FOR ALL SHIPMENTS:

☐ Indicate with an asterisk (*) the shipments listed above that require placards

☐ Ensure that consignee notification of arrival of shipment of the shipment has been requested

☐ Check here if additional information is attached

Comments: ______________________________

____

____

I hereby certify we are following the procedures outlined in the memorandum, *Approval of Commercial Shipments of Radioactive Materials and Waste on Behalf of the Office of Environmental Management,* and these procedures are being followed for these shipments. Required documentation is being maintained with the shipping papers for each shipment in accordance with the procedures.

______________________	______________________	______________________
Signature and Title, site/FO Requesting Official	Signature and Title, site/FO Requesting Official	Signature and Title, site/FO Requesting Official
Type/Printed Name: ____________	Type/Printed Name: ____________	Type/Printed Name: ____________
Date: ____________	Date: ____________	Date: ____________

U.S. Department of Energy

Oakland Operations Office, Oakland, California

FINAL STANDARD QUALITY PROCEDURES

For the

DOE AREAS AT THE LABORATORY FOR
ENERGY-RELATED HEALTH RESEARCH
UNIVERSITY OF CALIFORNIA, DAVIS

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

Prepared by:

Weiss Associates
5801 Christie Avenue, Suite 600
Emeryville, California 94608-1827

DOE Oakland Operations Contract DE-AC03-96SF20686

Weiss Associates
Environmental and Geologic Services

FINAL STANDARD QUALITY PROCEDURES

For the:

DOE AREAS AT THE LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH UNIVERSITY OF CALIFORNIA, DAVIS

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

Prepared by:

Weiss Associates
5801 Christie Avenue, Suite 600
Emeryville, California 94608-1827

DOE Oakland Operations Contract DE-AC03-96SF20686

Issued To: ____________________ Date: _______________

Copy No.: ________ ■ Controlled ☐ Uncontrolled

Approvals Page

FINAL STANDARD QUALITY PROCEDURES

for the:

DOE AREAS AT THE LABORATORY FOR ENERGY-RELATED HEALTH RESEARCH UNIVERSITY OF CALIFORNIA, DAVIS

Prepared for:

United States Department of Energy
Oakland Operations Office
1301 Clay Street
Oakland, California 94612-5208

Prepared by:

Weiss Associates
5801 Christie Avenue, Suite 600
Emeryville, California 94608-1827

October 11, 2010

Approved by: ______________________________ Date: ____________________

Robert O. Devany, R.G., C.H.G.
Project Manager
Weiss Associates

Approved by: ______________________________ Date: ____________________

Michael D. Dresen, R.G., C.H.G.
Program Manager
Weiss Associates

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AND LOG OF REVISIONS

STANDARD QUALITY PROCEDURES

FORMS FOR STANDARD QUALITY PROCEDURES

Note: SQPs and associated forms may be revised, added, or deleted in accordance with the provisions of the Quality Assurance Project Plan. SQPs and associated forms are not numbered sequentially. Therefore, a missing number in the above list does not signify that a SQP or associated form is missing.

CONTRACTOR QUALITY CONTROL PROGRAM

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) describes the Quality Assurance Project Plan (QAPP) developed to implement the quality requirements applicable to activities authorized by the Department of Energy (DOE) for work pertaining to the LEHR Environmental Restoration Project. These SQPs were prepared on behalf of the DOE by Weiss Associates in cooperation with IT Corporation and EMS for the express use on the LEHR Environmental Restoration Project. These SQPs are for use by each contractor performing work on the LEHR project and are intended to be used in lieu of any other contractor corporate policies pertaining to LEHR project work requiring application of the SQPs. These SQPs are intended to replace all SQPs previously used on the LEHR Environmental Restoration Project and will be employed for future LEHR project tasks unless revisions are implemented at a future date. The QAPP is applicable to quality affecting activities provided to the LEHR Project by Contractors and Subcontractors performing activities related to the DOE Contract.

2.0 REFERENCES

2.1 Quality Assurance Project Plan (QAPP)

2.2 SQP 4.1 - Document Control

3.0 DEFINITIONS

None.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Program Manager is responsible for the overall implementation of the QAPP. The Program Manager should establish and cultivate principles and practices that integrate quality requirements into the daily work and provide individuals performing the work with proper information, tools, support and encouragement to properly perform their assigned work.

4.1.2 The Project Manager (PM) is responsible for assisting the Program Manager to assure that the overall goals and objectives for the project and project tasks are clearly stated and communicated to participating personnel. The Project Manager will provide direct oversight and coordination of Project operations in order to assure that they are suitably controlled, including acting on the behalf of the Program Manager in his/her absence.

4.1.3 The Project Quality Assurance Manager (PQAM) is responsible for preparing the QAPP and applicable SQPs and Standard Operating Procedures (SOPs) which describe the implementation of the requirements of the QAPP for QA activities. He/She will prepare or coordinate the preparation or revision of the QAPP, and provide oversight and assistance in the implementation of the QAPP. Further, this individual will be the primary spokesperson on matters related to the Quality Assurance for the LEHR Environmental Restoration Project.

4.2 Program Basis

4.2.1 The QAPP was developed utilizing selected concepts from the best or accepted industry quality management practices and requirements from applicable national and international standards. These practices and requirements are based upon U.S. DOE Order 5700.6c "Quality Assurance" and QAMS 005/80 (EPA, December 29, 1980) "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans."

4.2.2 The implementing procedures presented in the QAPP, SQPs, and SOPs, are designed to implement the quality requirements contained in the QAPP applicable to the project activities. Specifically excluded from the QAPP are procedures for safety, security, and project administration.

4.3 Program Organization

4.3.1 SQPs and SOPs are developed to implement the requirements of the QAPP by Quality Control and Technical/Construction Personnel, as applicable. The SQPs and SOPs will be reviewed and approved by responsible management prior to their implementation.

4.3.2 Quality affecting SOPs prepared to perform project activities are prepared and revised by Technical/Construction Personnel under the direction of the Project Task Leaders (PTLs) and are reviewed and approved by the Program Manager, Project Manager, PQAM and, as applicable, the Project Health and Safety Manager/Radiological Control Manager.

4.3.3 The current revision of SQPs and SOPs required to implement the project activities are maintained in the project and site files, and are available from the Project or Site Records Administrator.

4.3.4 The task-specific QA plan will be prepared by the PTL and task Project Quality Assurance Specialist (PQAS) through a selection of the applicable quality criteria necessary to accomplish the scope of work, and will be approved by the PQAM. The selection and documentation of the quality criteria will be provided within an individual task-specific work plan. The Readiness Review (SQP 3.3) or the Preparatory Phase Inspection (SQP 7.1) for specific tasks will, in general, reference the applicable sections of the QAPP and SQPs/SOPs appropriate to the activities. Additional task specific requirements will be included within each Readiness Review or Preparatory Phase Inspection by the inclusion of text which either adds additional requirements or modifies existing requirements. This method will enhance the project office ability to provide a quick turnaround of individual project tasks as existing information which was previously approved will be used as the baseline for conducting the work of individual tasks. This will also provide consistency across the various project tasks, and allow a reduction in the overall time and cost required to implement work on tasks. Whenever practical, subcontractors will be integrated into the provisions of the SQPs and SOPs to avoid keeping concurrent multiple sets of standard procedures.

5.0 RECORDS

None.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

CLIENT SATISFACTION SURVEY

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities associated with the performance of project self-assessments for activities implemented during the performance of work.

2.0 REFERENCES

2.1 Quality Assurance Project Plan (QAPP)

2.2 SQP 4.2 - Records Management

3.0 DEFINITIONS

3.1 Client Satisfaction Survey

A survey performed by contractor upper management with a client to assess their satisfaction with the contractor's work performance and implementation of contract requirements. An effective total quality management tool used to evaluated a client's satisfaction with work performed.

4.0 PROCEDURE

4.1 General

4.1.1 This procedure establishes the process for identifying, assessing, and improving work practices. This effort will focus on improvement of work processes being used to achieve project objectives. A client satisfaction survey as conducted by the Program Manager will be utilized to review and evaluate specific criteria to determine the level of execution and recommend improvements in the implementation of project requirements and project management.

4.2 Responsibilities

4.2.1 The Program Manager has the overall responsibility for the development and implementation of the client satisfaction survey. He/She will delegate the authority, resources and personnel for the team to perform their assigned task. He/She is responsible for the performance of Client Satisfaction Surveys for the project on a periodic basis.

4.2.2 The Program Manager is responsible for monitoring the project activities concerning quality issues as raised during the client satisfaction survey process and for providing direction and assistance on improvement suggestions affecting the quality program.

4.2.3 The Project QA Manager (PQAM) is responsible for approving revisions or substitutions of the SQP forms.

4.3 Client Satisfaction Survey

4.3.1 The greatest measure of project success may rest with Client Satisfaction. This is of such importance that the Program Manager will direct this activity using the Client Satisfaction Survey form (Attachment 6.1), the Quality Management Client Survey form (Attachment 6.2), and/or the Quality Management Follow-up Questions form (Attachment 6.3). The survey should be performed on no less than an annual basis well before project completion to allow adequate time to evaluate and respond to client concerns. Appropriate client needs are to be identified prior to performing the survey to assure the information received is consistent with survey objectives. At the contract/program level, the appropriate client would be the appropriate DOE Contracting Officer. For assessing activities specific to individual tasks, the assigned Contracting Officers Representative for the project would be the appropriate client. The Program Manager will determine which Client Satisfaction Survey form(s) will be used and the client representatives that will be polled.

4.3.2 The Project Manager will be informed of the survey results, and copies of the survey will be sent to the PQAM, and the project files. When results warrant, a management meeting will be held to correct deficient activities.

5.0 RECORDS

Records generated as a result of implementing this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Client Satisfaction Survey Form

6.2 Quality Management Client Survey Form

6.3 Quality Management Client Follow-up Questions Form

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

CLIENT SATISFACTION SURVEY FORM

WEISS ASSOCIATES WA

Dear

Service is our product; Quality is our goal. Please indicate how you feel about the services billed this period. We greatly value your feedback.

1	2	3	4	5	6	7	8	9	10
Unhappy									Extremely Happy

Comments:

Michael D Dresen

Michael D. Dresen

Weiss Associates' Mission:

"WA is an innovative, thoughtful, service-driven team dedicated to achieving our client's environmental goals."

ATTACHMENT 6.2

QUALITY MANAGEMENT CLIENT SURVEY FORM

QUALITY MANAGEMENT CLIENT-SURVEY 1997

Name: Date:

Company:

1. Overall how would you rate the services Weiss Associates has provided you? Feel free to add your comments.

   1 2 3 4 5 6 7 8 9 10
   Poor Excellent

   Comments:

2. Why do you use Weiss Associates?

3. Are there things we can do to better help you meet your goals and those of your company?

4. Please rate your satisfaction with, and confidence in, WA staff with whom you work most closely.

WA Staff	Rating (1-10) 10=great	Amount of Contact (low, med, high)	Additional Comments

5. Please use the back of this page to provide any other additional comments that can help us serve you better. Thank you.

WA Interviewer Date

ATTACHMENT 6.3

QUALITY MANAGEMENT
CLIENTFOLLOW-UP QUESTIONS FORM

WEISS ASSOCIATES 1997 QUALITY MANAGEMENT CLIENT FOLLOW-UP QUESTIONS

Name: Date:

Company:

*** = Required Question**

1. What are the three primary characteristics you look for in an environmental consultant?*

2. Do you feel Weiss Associates (WA) matches the characteristics identified in question one? Why or why not?*

3. On a scale of 1 to 10, 10 being the highest, how do you perceive our overall performance compared to other consultants?*

4. Generally speaking, what are other consultants doing better than WA?

5. What are WA's strengths?*

6. What are WA's weaknesses?

7. What can we do to improve our services and better meet your needs?

8. Is our work cost competitive?*

9. How would you rate our communication:*

- On technical issues:
- On budget/cost:
- Overall:

10. Over the past year do you feel WA's reputation has gotten better, worse or stayed the same?*

11. WA has several service areas. Would you please comment on whether you have used WA in this area, would use WA if the need arose, or did not know we provided this service.

SERVICE	HAVE USED	WOULD USE	DID NOT KNOW
Site Characterization	☐	☐	☐
Engineering and Remediation	☐	☐	☐
Risk Assessment and Modeling	☐	☐	☐
Environmental Management Services	☐	☐	☐
Forensic Support	☐	☐	☐
Air Programs	☐	☐	☐
Innovative Technologies	☐	☐	☐

12. Other comments/questions/issues:

INDOCTRINATION AND TRAINING

STANDARD QUALITY PROCEDURE

1.0PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for the indoctrination and training of personnel who will perform quality-affecting activities~~ on the Contract~~.

2.0REFERENCES

2.1 Quality Assurance Project Plan

2.2 SQP 4.2 - Records Management

3.0DEFINITIONS

3.1 Indoctrination

To provide initial information to personnel which will familiarize them with the general criteria of the project/task activities, applicable quality criteria and job responsibilities.

3.2 Qualification (Personnel)

The characteristics or abilities gained through education, training, and/or experience, as measured against established requirements, such as standards, tests and/or evaluation that qualify a person to perform a required function.

3.3 Training

To impart specific information with regard to job functions which will achieve initial proficiency, maintain proficiency and adapt to changes in technology, methods or job functions.

4.0PROCEDURE

4.1 General Requirements

4.1.1 Scheduling of all training activities will be on an as-needed basis. Training will be conducted to assure personnel receive initial training and periodic refresher training when required.

4.1.2 Personnel will be indoctrinated, as a minimum, to the applicable quality plans and procedures, project/task objectives and goals, and applicable technical plans which identify technical criteria prior to performing work on a task. It is the responsibility of the Project Manager (PM) ~~or the Project Task Leader (PTL)~~ to ~~assure~~ ensure that personnel assigned to task activities attend a QA indoctrination training session which is conducted by the Project Quality Assurance Manager (PQAM) and/or~~/~~ the Project Quality Assurance Specialist (~~PQAM/~~PQAS).

4.2 Training

4.2.1 Training of personnel performing ~~quality~~ quality-affecting activities will be conducted in accordance with the training requirements established within the training ~~matrices~~ matrix (Attachment 6.1) for each ~~job~~ position on an assigned task.

4.2.2 The ~~Project Manager~~PM ~~or PTL~~ and the PQAM~~/PQAS~~ will develop training matrices which will ~~include the~~require project personnel to review planning documents and procedures. ~~The training matrices will identify by job classification the training requirements for the plans and procedures. Other required training (e.g., operator, equipment etc.) will also be identified.~~ Once completed, the training matrices will be reviewed by the PQAM and submitted to the project file.

4.2.3 The Project Health and Safety Manager (PHSM) will identify all health and safety training requirements and communicate these requirements to the PM. The PHSM will assist the PM in verifying the all of these training requirements have been met.

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~~4.2.3~~4.2.4
raining will be performed using any or all of the following ~~methods or a combination of the methods listed below~~:

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- Training provided by a manufacturer or supplier;
- Classroom instruction;
- On-the-job training with demonstration of capabilities on actual equipment; or,
- Required reading assignments.

~~4.2.4~~4.2.5
raining instructors will be designated by the ~~Project Manager~~PM or PTL based on ~~operation and/or~~their experience with the particular subject. ~~He/she will have the option of using vendor representatives or a combination of vendor and project/task personnel for instructors, as appropriate.~~

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4.3 Project Task Requirements

4.3.1 The PTL is responsible for ensuring that site personnel are properly indoctrinated and trained in the implementation of project task plans and procedures prior to their involvement in project task activities.

4.3.2 ~~Attendance of indoctrination and~~Instructors are responsible for ensuring that training ~~will b~~attendance is~~e~~ documented on a Training Attendance Record (Attachment 6.3~~), and/or Required Reading Checklist (Attachment 6.4), as applicable~~. Instructors will submit these records to the project file following completion of the training sessions.

4.4 Equipment Training

4.4.1 Personnel will be trained and qualified in the operation, maintenance, repair, and calibration of equipment, instruments, and tools prior to their utilization.

4.4.2 The instructor will provide training by reviewing ~~with trainees~~ the operational procedure or operation and maintenance manuals of the equipment manufacturer.

~~4.4.3~~The trainee will demonstrate for the instructor the proper operation and maintenance of equipment through utilization of that equipment~~,~~ or

~~4.4.4~~4.4.3 ~~T~~
~~he trainee will demonstrate for the instructor on~~ an authentic mock-up the safe operation and maintenance where this is more practical.

~~4.4.5~~4.4.4 I
f equipment manufacturers or suppliers can provide acceptable training in the operation and servicing of their equipment, those services will be utilized.

5.0RECORDS

Records generated as a result of this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0ATTACHMENTS

6.1 Training Matrix Form

6.2 Training Attendance Record

~~*6.3Required Reading Checklist*~~

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

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ATTACHMENT 6.1

TRAINING MATRIX FORM

PROJECT OFFICE PERSONNEL
QUALITY ASSURANCE DEPARTMENT
TRAINING MATRIX

Approved By:______________________________ **Date:**
Project Manager

Approved By:______________________________ **Date:**
PQA Manager

PROJECT DOCUMENT:

POSITION/TITLE	DOCUMENT SECTION NUMBER																	

J:\DOE\4000\D3\SQ&OPS\WASQPS\SQPFORMS\SQP03_2A.DOC

ATTACHMENT 6.2

TRAINING ATTENDANCE RECORD

TRAINING ATTENDANCE RECORD

Company:			
Subject:			Date:
Instructor:		Location:	Contact Hours:
Brief Course Description:			

Name	Signature	Organization/Project	Position

~~ATTACHMENT 6.3~~

~~REQUIRED READING CHECKLIST~~

READINESS REVIEW INSPECTION

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for the performance and documentation of Readiness Review Inspection for activities performed during project tasks to ensure compliance with project requirements. The Readiness Review Inspection is designed to demonstrate that it is safe to start or resume a project field task at the LEHR site. The inspections are not intended to be tools of line management to confirm readiness. Rather, the inspections provide an independent verification of readiness to start or restart an activity at the LEHR site. This inspection is very similar to the Preparatory Phase Inspection (SQP 7.1) and differs primarily in DOE notification and/or involvement in the Readiness Review Inspection.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan (QAPP)*

2.2 *SQP 4.2 - Records Management*

2.3 *SQP 7.1 - Quality Inspections and Inspection Records*

2.4 *SQP 10.1 - Nonconformance Control*

3.0 DEFINITIONS

3.1 Inspection

Examination or measurement to verify whether an item or activity conforms to specified requirements.

4.0 PROCEDURE

4.1 Qualification of Inspectors

4.1.1 Personnel performing inspection activities will have the necessary expertise in the area to be inspected, but will be sufficiently independent of the activity performed.

4.1.2 Prior to performance of inspection activities, personnel designated for that responsibility will review and be thoroughly familiar with the procedures, regulations, etc., governing the activities to be inspected.

4.2 Field Inspection Plans and Reports

4.2.1 Project activities requiring inspection (i.e., Preparatory Phase, Initial Phase and Follow-up Phase) will have an Items to Inspect Checklist (see SQP 7.1) or similar work product (or checklist) prepared for that activity. Inspection(s) will be performed for activities which are identified for major tasks and will be performed consistent with ongoing project activities. As deemed applicable by the Project Manager and the PQAM, a Preparatory Phase Inspection Checklist for each task shall be prepared by the Project Task Leader.

4.2.2 The Items to Inspect checklist will identify the items and activities to be inspected. If hold points are required, the definable Items to Inspect checklist will identify them and indicate required notifications and sign-offs. The Project Manager and PQAM will limit the number of Items to Inspect to ensure that undue inspection activities are not spent on smaller tasks.

4.2.3 If a Nonconformance Report (SQP 10.1) is required for activities being inspected, a reference will be provided on the Contractor QC Report (see SQP 7.1).

4.2.4 The Contractor QC Reports will be issued identifying inspections performed. The report will be completed by the Project QA Specialist (PQAS) and will address each inspection performed during the course of the daily activities.

4.2.5 Items or activities not conforming to inspection acceptance criteria will be resolved and, when determined necessary, documented on a Nonconformance Report. Contractor QC Reports will be logged and sequentially numbered by project task. Each Contractor QC Report will be signed by the PQAS certifying that the activities listed within the report have been completed in accordance with the project planning documents to the best of his/her knowledge.

5.0 RECORDS

Records generated as a result of this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

PREPARATORY PHASE PLANNING GUIDANCE

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for planning of all field-related activities to ensure compliance with project requirements. The Preparatory Phase Planning Guidance is designed to facilitate the project/task planning process and solicit input from the relevant facets of the organization.

2.0 REFERENCES

2.1 Quality Assurance Project Plan (QAPP)

2.2 SQP 4.2 - Records Management

3.0 DEFINITIONS

3.1 Planning

Planning means the identification of the systematic sequence of operations and the overall methods to achieve the requisite quality of work.

4.0 RESPONSIBILITIES

4.1 Project Manager

It is the Project Manager's (PM's) responsibility to initiate the planning so that pre-work activities are accomplished in a timely manner and are adequate for the scope of work involved.

4.2 Project Delegation

The PM may delegate the project planning activities. Any delegations must be documented. The PM is responsible for ensuring the person to whom the work is delegated has qualifications commensurate with the responsibilities being assigned.

5.0 APPLICABLITY

Completion of the Preparatory Phase Planning Guidance is required for all field activities. Section 3.3 of the QAPP defines which activities necessitate the development of a Work Plan.

6.0 WORK PLANNING

6.1 *All project activities must be evaluated to ensure that they will meet program requirements, stated objectives and take into account the public, the worker and the environment.*

6.2 *The Pre-Phase Planning Guidance Form (Attachment 8.2) will assist in the identification of program requirements applicable to fieldwork activities and will facilitate input from all relevant sectors of the LEHR organization, such as the Health and Safety staff.*

6.3 *The Preparatory Phase Planning Guidance Form will document the work planning process.*

7.0 RECORDS

Records generated as a result of this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

8.0 ATTACHMENTS

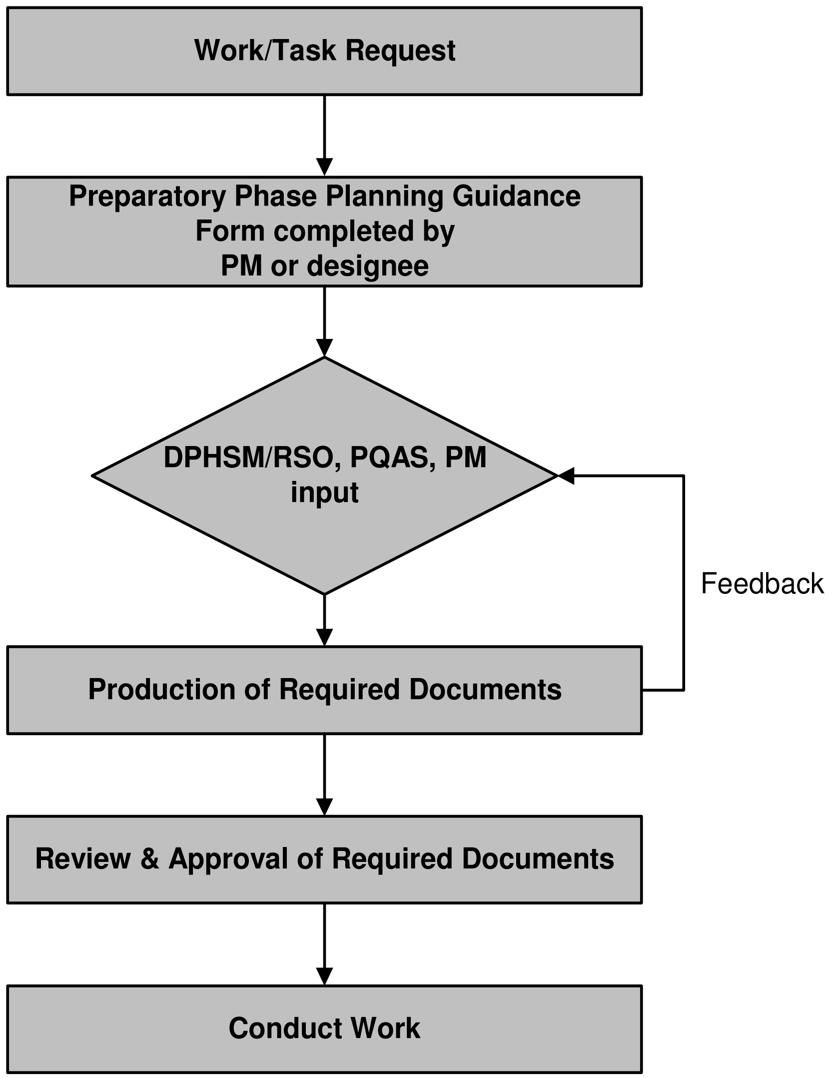
8.1 Preparatory Phase Planning Flowchart

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

8.2 Pre-Phase Planning Guidance Form

ATTACHMENT 8.1

PREPARATORY PHASE PLANNING FLOWCHART


Work/Task Request
Preparatory Phase Planning Guidance Form completed by PM or designee
DPHSM/RSO, PQAS, PM input
Feedback
Production of Required Documents
Review & Approval of Required Documents
Conduct Work

ATTACHMENT 8.2

PRE-PHASE PLANNING GUIDANCE FORM

Attachment 8-2. Pre-phase Planning Guidance Form

Instructions

Project Scope and Management: Provide task information, scope and dates. Describe how each item will be addressed. If an item is not applicable, indicate why.

Project Documents and Personnel Training: Use the following legend. (i.e., if item is applicable and covered by existing document, enter S)

***Legend**
NA = Not Applicable. Provide an explanation.
A =Applicable. Enter **S, R** or **N** (*see below*) Describe action to be taken.
S = Existing document is satisfactory.
R = Document exists, but requires revisions to cover proposed activities.
N = New document needed.
? = Do not know, need asssistance in making the determination - indicate who should provide guidance (e.g., **?, PHSM/RCM**).

Approvals and Distribution:
Once completed and signed by the originator and approved by the PM, the form should be circulated expeditiously (e.g., e-mail) to reviewers and the CC list. Comments from those on CC list should be **returned to the originator within two (2) business days**.
Approval by default will result if no comments are received.

Approval, Review and Distribution

	Name:	Date:	CC:
Prepared by:	____________	________	PQAM
PM Approval:	____________	________	EMS PM
Reviewed by:			IT PM
PM/PTL	____________	________	RCM
PQAM	____________	________	DRCM
DPHSM/RSO	____________	________	SHSO
			PHSM
			WC

Project Scope and Management

Task Name: ____________________
Task Number: ____________________
Anticipated Field Work Dates: ____________________
Scope:

Item	Description
Task objectives	
Roles & responsibilties	
Delegation of authority documented	
Primary activities	
Data requirements	
Data quality objectives	
Schedule	
Budget	
Resource allocation (including subcontractors)	
Quality Assurance/Quality Control	

Attachment 8-2. Pre-phase Planning Guidance Form

Health & Safety/Hazards	
Other - specify	

Project Documents

Item	Applicable /Status*	Proposed Action / Explanation
Work Plan (or equivalent)		
Environmental Analysis/Protection		
Quality Assurance Project Plan		
Project Health & Safety Plan		
Contingency Plan and General Emergency Response Procedures		
Waste Management Plan		
Waste Min./Pollution Prevention		
Sampling & Analysis Plan		
Activity Hazard Analysis		
As-Low-As-Reasonably-Achievable Program Evaluation		
Hazardous Work Permit		
Monitoring Guidelines		
Standard Quality Procedures		
Standard Operating Procedures		
Health and Safety Procedures		
Guidance Documents		
Other - specify		

Personnel Training

Item	Applicable / Status*	Proposed Action / Explanation
Training Matrix Including:		
Pre-task Training		
Task-specific Training		
Program Training		
On the Job Training (OJT)		
Subcontractors		
Other - specify		

*
NA = Not Applicable. Provide explanation.
A =Applicable. Enter **S, R** or **N** (*see below*) Describe action to be taken.
S = Existing document is satisfactory.
R = Document exists, but requires revisions to cover proposed activities.
N = New document to be produced.
? = Do not know, need asssistance in making the determination - indicate who should provide guidance (e.g. ?, PHSM/RCM).

Additional Comments

DOCUMENT CONTROL

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities associated with the control and distribution of project documents.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan*

2.2 *SQP 4.2 - Records Management*

2.3 *SQP 5.1 - Preparation, Revision and Approval of Plans and Procedures*

2.4 *SQP 11.1 - Field Work Variance*

3.0 DEFINITIONS

3.1 Planning Documents

Those documents which establish the requirements and methods to implement the project activities. These documents are identified as Work Plans, Quality Assurance Project Plan (QAPP), Project Health and Safety Plan (PHSP), Standard Quality Procedures (SQPs), Standard Operating Procedures (SOPs), Health and Safety Procedures (HSPs), Contingency Plan and General Emergency Response Procedures (CPGERP), and Field Work Variances (FWV).

3.2 Controlled Documents

Documents which have been assigned a unique identifier and issued to a specific person, discipline, or facility. These documents are maintained current by accounting for their initial issue and revisions.

3.3 Uncontrolled Documents

A document which is issued current, but which is not maintained current with revisions.

3.4 Decontrolled Documents

A copy of a controlled document which is issued current, but which is not maintained current with revisions.

Decontrolled copies of controlled documents may be issued for informational purposes to parties not directly performing the governed work, but these copies must be clearly identified as decontrolled copies of a controlled document.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Project Manager/Task Leader is responsible for the control of project/task plans, procedures, and FWVs. This includes establishing and maintaining lists of personnel who are issued controlled copies of those documents.

4.1.2 The Project Records Administrator (PRA) is responsible for the full implementation of the requirements of this SQP.

4.2 Control and Distribution

4.2.1 Once project documents have been prepared and approved, they will be issued to applicable personnel who are identified as controlled document holders.

4.2.2 Distribution of project plans and procedures will be controlled via the Document Control Log (Attachment 6.1). The distribution of new or revised documents will be by use of a Document Transmittal form (Attachment 6.2).

4.2.3 A controlled copy document may be reissued to another document holder upon a written request. Reissuing an already existing controlled copy document to a new document holder will be done by transmitting a new cover page.

4.3 Receipt Acknowledgment

4.3.1 The recipient of the controlled plan, or procedure, will:

1. Acknowledge receipt of the plan and revisions, and certify that his/her plan is in agreement with the document transmittal by signing and returning a copy of the Document Transmittal form to the originator. The recipient receiving revisions to the plan destroys obsolete pages and replaces them with the new revised pages of the plan.
2. Acknowledge receipt of the procedure and revisions by signing and returning a copy of the Document Transmittal form to the originator. The recipient

receiving revisions to the procedure destroys obsolete procedure and replaces them with the new revised procedure.

3. Acknowledge receipt of the FWV by signing and returning a copy of the Document Transmittal form to the originator.

4.4 Receipt Acknowledgment Follow-up

4.4.1 If the recipient fails to return the Document Transmittal form within 30 working days within the contractor organization and 40 working days outside the contractor organization, the PRA takes follow-up measures via memorandum to assure the Document Transmittal form is returned within an additional 5 working days within WA and 10 working days outside WA. Should the recipient fail to respond to the follow up measures pertaining to the plan, his/her plan will be redesignated as "Uncontrolled." Should the recipient fail to respond to the follow up measures pertaining to procedure or FWV, the recipient will be removed from distribution and notified by memorandum that his/her project document is being designated uncontrolled.

4.5 Revisions

4.5.1 Revisions to approved plans and procedures will be issued in the same manner as the original. Superseded record copies will be marked "Superseded by Revision X" in the project record files.

5.0 RECORDS

Records generated as a result of implementing this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Document Control Log

6.2 Document Transmittal Form

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

DOCUMENT CONTROL LOG

MANUAL CONTROL LOG

Company: Weiss Associates

Document Name:

Revision: Date:

Document Number	Issued To (Name, Address)	Date Issued		Revision and Addenda Control (fill in Rev. #/Date)					
		Issued	Ackn.	Issued	Ackn.	Issued	Ackn.	Issued	Ackn.

ATTACHMENT 6.2

DOCUMENT TRANSMITTAL FORM

DOCUMENT RECEIPT ACKNOWLEDGEMENT FORM

THE FOLLOWING CONTROLLED COPY

Copy No.: «DocNum»

OF DOCUMENTS WHICH COMPRISE LEHR PROJECT OR PORTIONS THEREOF ARE BEING TRANSMITTED FOR YOUR IMPLEMENTATION AND USE. PLEASE SIGN/DATE THIS DOCUMENT TRANSMITTAL ACKNOWLEDGING YOUR RECEIPT OF THE DOCUMENT(S) LISTED BELOW.

DOCUMENT NAME:
Final Radiological Protection Program

DOCUMENT REVISION/DATE:
Rev. 3, 11/19/99

NOTE:

ISSUED TO AND LOCATION:

Name	«Recipient»
Company	«Company»
Address	«Address»
City, State, Zipcode	«CityStateZip»

HAVE RECEIVED THE ABOVE LISTED DOCUMENTS

Name (Printed): ____________________

Name (Signed): ____________________

Company Name/Office: ____________________

Date Received: ____________________

PLEASE COMPLETE THIS RECEIPT AND RETURN TO:

LEHR Librarian
WEISS ASSOCIATES
5801 CHRISTIE AVENUE, SUITE 600
EMERYVILLE, CA 94608

RECORDS MANAGEMENT

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities associated with the management of project and task records.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan*

2.2 *SQP 4.1 - Document Control*

2.3 *SQP 10.1 - Nonconformance Control*

3.0 DEFINITIONS

3.1 Records

All forms of documentation relating to a project, including but not limited to paper and electronically stored documents, photographs, and video/audio tapes.

3.2 Administrative Documents

Those documents which do not directly provide objective evidence of the quality of items or activities, or compliance to the contract or regulatory requirements.

3.3 Quality Control Record

A completed document that furnishes objective evidence of the quality of items, and/or activities affecting quality or compliance to the contract or regulatory requirements.

4.0 PROCEDURE

4.1 Discussion

Accurate records are critical to a project for historical purposes, including liability and regulatory issues. The proper management of these records is necessary to ensure that historical representation of project activities is maintained.

4.2 Responsibilities

4.2.1 The Program Manager has the overall responsibility for the management of records including but not limited to providing for adequate storage facilities, maintenance of those facilities and assuring implementation of this SQP. He/she will designate those personnel authorized to remove program records from the records file area.

4.2.2 The Project Manager reports to the Program Manager and is responsible for the collection, maintenance, and control of project records.

4.2.3 The Project Records Administrator (PRA) reports to the Project Quality Assurance Manager (PQAM) and is responsible for properly filing records in the project records file, ensuring that only authorized personnel are allowed access to the records file area, and providing the Site Records Administration (SRA) with copies of project records for the Site files.

4.2.4 The Site Records Administrator (SRA) reports to the Project Manager and is responsible for properly filing and maintaining project records in the Site office and, as a minimum, sending originals or legible and reproducible copies weekly to the PRA.

4.2.5 The PQAM reports to the Program Manager and is responsible for performing audits and surveillances of record files to verify the effectiveness of the records control system.

4.2.6 The Project QA Specialists (PQAS) report to the PQAM and are responsible for monitoring the records control system of project records for specific tasks.

4.3 Receipt

4.3.1 All incoming project and task records and administrative documents received at the project office will be sent to the PRA. He/she will stamp and date the document (Received (date) LEHR Project." The stamped records will then be distributed to the addressed individual for review and additional distribution designation if needed. Records generated in the field will be packaged and sealed at the end of each field activity, as a minimum, and sent to the PRA in the project office for incorporation into the records files. If the PRA receives the package with a broken seal, he/she will contact the sender to assure no records were lost. If records are missing, copies will be generated from the field records files and sent with the next shipment to the PRA.

4.4 Indexing and Filing

4.4.1 Records will be organized into file categories, using the Records Inventory and Disposition Schedule/File (RIDS) index system. Since all categories may not be applicable to specific project tasks, categories may be added or deleted as needed to support the project contract. A copy of the tailored index will be maintained with the project records file and identified as the file index. The project Site office will receive a copy of the updated file index as needed.

4.4.2 Working documents will be maintained in the project office but are not required to be filed as records until they are finalized.

4.4.3 Records will be permanently filed in the project files unless specifically required as submittals in the Contract.

4.5 Storage

4.5.1 Records will be stored in a manner which will preclude their loss, damage or tampering. The PRA will effect administrative procedures and physical safeguards to ensure the security of the records in the project office. The project records filing area will be controlled with limited access of unauthorized personnel. The PRA, Project Manager, and Program Manager will have keys to the filing area. Any other project personnel wishing to sign out records from the filing area must get access from one of these three people.

4.6 Temporary Issue

4.6.1 Records or files may be reviewed from stations within the filing area. In the event a record needs to be removed from the project filing area, a copy of the record can be requested from the PRA. Copies of records or information will be kept to a minimum, copying only the specific information needed rather than an entire document. Copies of records will be stamped "copy" by the PRA prior to exiting the filing area.

4.6.2 Bound copies of selected documents in the project files may be checked out to project personnel by the PRA. The PRA will use Attachment 6.1, Record/File Check-out Sheet, or its equivalent, to issue records or files to users, filing it in the place of the record or file until the record or file is returned.

4.7 Project Close-out

4.7.1 Upon demobilization from the project site, the Project Manager will turn over unsubmitted project files to the PRA for incorporation into the project files. The RIDS index will be checked and updated as necessary during the integration process.

4.8 Records Retention

4.8.1 Records will be retained based on client and regulatory requirements, and company policy. Where no specific guidance is available, the Project Manager will make this determination. Typical retention time periods from the completion of the project are:

- Records prepared as part of site investigations, e.g., RI/FS activities - 10 years;
- Records associated with facilities governed by the Resource Conservation and Recovery Act (RCRA) - 5 years after closure if the project was performed prior to closure, or for the duration of the 30-year monitoring period following closure if the project was preformed for the purpose of closure monitoring;
- Records associated with nuclear projects, e.g., site characterization, geological respiratory design, and respiratory seal design - life of facility; and,
- Records for conventional projects - 7 years.

The PRA will mark the appropriate retention years and date on the front of the file index upon closure of the project or contract.

4.9 Record Disposal

Prior to disposal of records that have exceeded their retention time, the EPA will be notified of the intent to dispose such records and will be provided with an opportunity to take possession of these records.

~~4.9~~4.10 Nonconformance

~~4.9.1~~Any significant deviation to this SQP will be reported by the individual who discovers the deviation.

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5.0 RECORDS

Records generated as a result of implementing this SQP will be controlled and maintained in the project record files in accordance with this SQP.

6.0 ATTACHMENTS

6.1 Record/File Check-Out Sheet

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

RECORD/FILE CHECK-OUT SHEET

RECORD/FILE CHECK-OUT SHEET

Record/File: ______________________________

Company: ______________________________

Date: ______________________________

User's Name: ______________________________

User's Signature: ______________________________

Telephone Number: ______________________________

RECORDS TRACKING

STANDARD OPERATING PROCEDURE

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures, to be used by all contractor and subcontractor personnel, for records tracking. Detailed logs and attention to these guidelines are necessary to assure the quality and integrity of all records. Additional specific procedures and requirements will be provided in the project work plans, as necessary.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan, WA 1997*

2.2 *SOP 4.2 - Records Management, WA 1997*

3.0 DEFINITIONS

3.1 Records

All forms of documentation relating to a project, including but not limited to paper and electronically stored documents, photographs, and video/audio tapes.

3.2 Incoming Log

The document used to track all incoming records.

3.3 Outgoing Log

The document used to track all outgoing records.

4.0 PROCEDURE

This section contains both the responsibilities and procedures involved with records tracking. Adherence to proper records procedures is necessary to ensure the quality and integrity of the records. Accurate records are critical to a project for historical purposes, including liability and regulatory issues. The details within this SOP should be used in conjunction with SQP 4.2 (Records Management) and project work plans.

4.1 Responsibilities

4.1.1 The Program Manager has the overall responsibility for the management of records including but not limited to providing for adequate storage facilities, maintenance of those facilities and assuring implementation of this SOP.

4.1.2 The Project Manager reports to the Program Manager and is responsible for the collection, maintenance, and control of project records. He/she will designate in writing those personnel authorized to remove project records from the records file area.

4.1.3 The PQAM reports to the Program Manager and is responsible for performing audits and surveillances of records files to verify the effectiveness of the records control system.

4.1.4 Each Task Leader reports to the PQAM and is responsible for monitoring the records control system of project records in the field office.

4.1.5 The Project Records Administrator (PRA) reports to the PQAM and is responsible for properly logging incoming and outgoing records, filing records in the Project records file and ensuring that only authorized personnel are allowed access to the records file area.

4.1.6 The Site Office Records Administrator (SARO) reports to the Project Manager and is responsible for properly filing and maintaining project records in the field office and, as a minimum, sending originals and reproducible copies weekly to Project Administrator.

4.1.7 Each member of the Project team is responsible for informing the PRA when in receipt of, or issuing, documentation critical to the Project.

4.2 Receipt

4.2.1 All incoming Project record(s) and administrative documents received at the Program office will be sent to the PRA. He/she will stamp and date the document "Received (date) LEHR Project" and log the receipt in the Incoming Log. The stamped record(s) will then be distributed to the addressed individual for review and additional distribution designation. The addressee will send the original to the Program office records files and distribute additional copies if needed.

4.2.2 Records generated in the field will be packaged and sealed weekly by the SORA, as a minimum, and sent to the PRA in the Program office for incorporation into the records files. If the PRA receives the package with a broken seal he/she will contact the sender to assure no records were lost. If records are missing, copies will be generated from the field records files and sent with the next shipment to the PRA.

4.3 Indexing and Filing

4.3.1 Records will be organized into file categories, using the DOE RIDS file system. Since all categories may not be applicable to specific project tasks, categories may be added or deleted as needed to support the project contract. A copy of the tailored index will be maintained in the front of the program records file and identified as the file index. The project field office will receive a copy of the updated file index as needed.

4.3.2 Working documents will be maintained in the project office but are not required to be filed as records until they are finalized.

4.3.3 Records will be permanently filed in the project files unless otherwise specifically required by the client.

5.0 RECORDS

None

6.0 ATTACHMENTS

6.1 Incoming Correspondence Log

6.2 Outgoing Correspondence Log

A form referenced or attached to this SOP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

INCOMING CORRESPONDENCE LOG

ATTACHMENT 6.2

OUTGOING CORRESPONDENCE LOG

PREPARATION, REVISION AND APPROVAL OF PLANS AND PROCEDURES

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities associated with the preparation, revision, and approval of quality-affecting documents.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan (QAPP)*

2.2 *Project Health and Safety Plan (PHSP)*

2.3 *SQP 4.1 - Document Control*

2.4 *SQP 4.2 - Records Management*

2.5 *SQP 11.1 - Field Work Variance*

3.0 DEFINITIONS

3.1 Quality Assurance Project Plan (QAPP)

A plan describing the quality assurance requirements to be applied, as applicable, to the project requirements, which includes the methods and responsibilities established to meet those requirements specified.

3.2 Standard Quality Procedures (SQPs)

A set of implementing procedures which establish the responsibilities and describe the methods of performing quality-affecting activities in response to QAPP requirements.

3.3 Standard Operation Procedures (SOPs)

A set of implementing procedures which prescribe the actions necessary to complete a work operation in accordance with accepted practices for quality and safety.

3.4 Health and Safety Procedures (HSPs)

A set of implementing procedures which describe the actions necessary to ensure project work is conducted within accepted practices for health and safety.

3.5 Quality Improvements

A change in any aspect of the project that will result in meeting the quality goals of this project with a corresponding improvement in project efficiency or reduction in project costs.

4.0 PROCEDURE

4.1 Discussion

4.1.1 The QAPP is established and maintained as the documented basis for compliance with the project quality assurance requirements. The QAPP emphasizes the contractor's commitment to meeting those requirements. The associated SQPs and SOPs establish methods and responsibilities for complying with those commitments.

4.2 Responsibilities

4.2.1 The Program Manager has the responsibility to assure that the QAPP is implemented effectively by project personnel. Further, the Program Manger is responsible to ensure that SOPs which are required for project performance are prepared by qualified personnel and are reviewed and approved by authorized personnel, prior to the implementation of project activities.

4.2.2 The Project Quality Assurance Manager (PQAM) is responsible for the preparation and maintenance of the QAPP and SQPs. The PQAM reviews and approves SOPs to assure compliance with the requirements of the QAPP and that they constitute an acceptable approach to meeting QA objectives. He/She is also a part of the approval cycle for the technical project planning documents (e.g., work plan, sampling and analysis plan, etc.).

4.2.3 The Project Health and Safety Manager (PHSM) is responsible for site preparation and maintenance of HSPs. The PHSM reviews and approves HSPs to assure compliance with the requirements of the PHSP. He/She initiates revision to the HSPs due to programmatic requirement changes, audit findings, or corrective actions, as applicable.

4.3 Preparation

4.3.1 The PQAM determines the need for establishing a procedure describing how to perform quality-affecting activities. He/She also initiates revisions to these documents due to programmatic requirement changes, audit findings, or corrective actions, as applicable.

4.3.2 Procedures, Field Work Variances (FWV), and drawings will include appropriate qualitative and quantitative acceptance criteria for determining satisfactory work performance and quality compliance.

4.4 Format

4.4.1 The SQPs, SOPs, and HSPs will adhere to a consistent format in accordance with the following guidelines.

4.4.2 Revision Block - This area will contain the document identification, section or procedure number, revision number, date, and pages. This information will appear on each page of the document.

4.4.3 Title Block - This area will contain the title of the SQP, SOP or HSP and will appear on the first page only.

4.5 Contents

4.5.1 Procedures required to implement project task activities will include the information listed below. When any of these items are not required or are inappropriate to the SQP, SOP, or HSP, they will be noted by the word "none."

4.5.2 Describe the purpose of the SQP, SOP or HSP. Be as specific as possible; do not generalize.

- ***References*** - Identify pertinent documents or procedures that interface with the SQP, SOP or HSP being prepared. Reference to specific documents that are directly applicable to the SQP, SOP or HSP (e.g., QAPP, PHSP, etc.) is acceptable.
- ***Definitions*** - Define words and phrases having a special meaning of application within the SQP, SOP or HSP. Definitions must be consistent with the glossary of terms located within the QAPP.
- ***Procedure*** - Identify the sequence of activities to be followed and assign responsibility for accomplishing activities, be specific in context. Include appropriate reporting requirements for assuring that important activities have been satisfactorily accomplished and incorporate examples of forms or documents which are required to be completed as a result of the procedure implementation.
- ***Records*** - If there are any special record handling requirements, identify them in this section; otherwise, state that records generated will be maintained in accordance with the SQP for records management.
- ***Attachment*** - List all attachments that will be included within the specific SQP, SOP or HSP.

4.6 Approval

4.6.1 The signature of the Program Manager or Project Manager and PQAM, and others as deemed necessary by the Program or Project Manager on the Table of Contents and Log of Revisions or cover page will signify the documents and revisions listed are authorized for use. For SQPs and SOPs, the Program Manager, Project Manager and PQAM will sign the Table of Contents and Log of Revisions page of the procedure manual indicating their approval.

4.7 Manual Change Requests

4.7.1 Personnel responsible for complying or interfacing with the requirements of the QAPP, SQPs or SOPs may request revisions to these documents via the Document Change Request (DCR) form, Attachment 6.1. Document change requests are different from field work modifications, as they are used to suggest improvements to existing processes or systems and are not structured to adjust the plans and procedures based on changing site conditions.

4.7.2 Originators of DCRs are responsible for completing Sections I through V on the DCR form. The originator will then forward the DCR to the PQAM for dispositioning.

4.7.3 The PQAM and line management are responsible for reviewing all DCRs and either accepting or rejecting them. If a DCR is accepted, the PQAM will indicate this acceptance by marking the appropriate block on the form and signing and dating the DCR. He/She will forward a copy of the signed DCR to the originator for their files. A copy of accepted DCRs will be maintained by the PQAM for logging and revision inclusion.

4.7.4 If a DCR is not accepted, the PQAM will indicate this by marking the appropriate space on the form and signing and dating the DCR. Non-accepted DCRs will be maintained in the project files.

4.8 Quality Improvement

4.8.1 Personnel responsible for complying or interfacing with the requirements of any aspect of this project may request quality improvements via the Quality Improvement Request (QIR) form, Attachment 6.2. QIRs are used to suggest improvements to existing processes, systems, or procedures based on changing site conditions or observations of project inefficiency.

4.8.2 Originators of QIRs are responsible for completing Sections I through V on the QIR form. The originator will then forward the QIR to the PQAM for dispositioning.

4.8.3 The PQAM and line management are responsible for reviewing all QIRs and either accepting or rejecting them. If a QIR is accepted, the PQAM will indicate this acceptance by marking the appropriate block on the form and signing and dating the QIR. He/She will forward a copy of the signed QIR to the originator for their files. A copy of accepted QIRs will be maintained by the PQAM for logging and revision inclusion. The Project Team will be notified of each QIR that has been implemented.

4.8.4 If a QIR is not accepted, the PQAM will indicate this by marking the appropriate space on the form and signing and dating the QIR. Non-accepted QIRs will be maintained in the project files.

4.9 Revisions

4.9.1 Revisions to an approved QAPP, SQP, SOP or technical planning document will be documented and will receive the same level of review, approval, and control as the original document.

4.9.2 Field Work Variances (SQP 11.1) will be issued by the PQAM using the FWV form. When twelve (12) months have elapsed for a Field Work Modification Form or six (6) have been issued, whichever comes first, the PQAM may elect to issue new revisions to the affected documents to incorporate the FWV.

4.10 Distribution and Control

4.10.1 SQP 4.1 describes the procedures for distributing and controlling the planning documents, QAPP, and procedures.

5.0 RECORDS

The original and originals of revisions of the QAPP, SQPs, and SOPs will be controlled and maintained in the program record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Document Change Request

6.2 Quality Improvement Request

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

DOCUMENT CHANGE REQUEST

DOCUMENT CHANGE REQUEST

Company:

I	Change Requested For		
	a. Document:	e. Paragraph:	DCR No.:
	b. Procedure:	f. Attachment:	Date Received:
	c. Section:	g. Page Rev.:	____ Manual
	d. Page:	h. Other:	____ Procedure
II	Present Verbiage		
III	Proposed Verbiage		
IV	Reason for Change		
	Submitted by:	Location:	Date:
V	Disposition		
	_____ Accepted		_____ Major Change
	_____ Not Accepted		_____ Minor Change
	PQA Manager:		Date:
VI	Incorporation		
	Manual/Procedure:		
	Revision:		Date:

cc: Originator (completed request)

ATTACHMENT 6.2

QUALITY IMPROVEMENT REQUEST

QUALITY IMPROVEMENT REQUEST

Company:

I	Change Requested For		
	a. Document:	e. Paragraph:	QIR No.:
	b. Procedure:	f. Attachment:	Date Received:
	c. Section:	g. Page Rev.:	____ Manual
	d. Page:	h. Other	____ Procedure
II	Present Quality Issue		
III	Proposed Quality Improvement		
IV	Reason for Quality Improvement		
	Submitted by:	Location:	Date:
V	Disposition		
	_____ Accepted Remarks:		
	_____ Not Accepted Remarks:		
	PQA Manager:		Date:
VI	Incorporation		
	Manual/Procedure:		
	Revision:		Date:

cc: Originator (completed request)

PREPARATION, REVIEW, AND APPROVAL OF PROCUREMENT DOCUMENTS

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the procedure to be used for the preparation, review, and approval of procurement documents. Procurement of items and services will be performed in accordance with Company purchasing policies and approved Program or Project documents that identify applicable technical and quality requirements.

2.0 REFERENCES

Quality Assurance Project Plan

SQP 4.2 - Records Management

SQP 7.2 - Receipt Inspections

3.0 DEFINITIONS

3.1 Procurement Document

Procurement documents include contracts and purchase orders.

3.2 Procurement Requisition (PR)

A form used to document an authorized request for materials or services and used to generate procurement documents.

3.3 Purchase Order (PO)

A form used between the Contractor and a vendor or supplier authorizing them to provide goods or services as described on the PO in return for payment of the agreed price.

3.4 Vendor

A supplier of materials, parts or items of equipment.

3.5 Subcontractor

A company contracted with to provide a service or perform work in support of the Contractor.

3.6 Quality Affecting Service or Item

Anything having an adverse impact on the ability of an item, process or service to meet or exceed the user's requirements or expectations that are embodied in the project specifications, applicable regulatory requirements, codes, standards and the protection of the health and safety of the public and workers.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Project Manager is responsible for assuring that all documentation and resulting procurements are performed in accordance with Company Corporate purchasing policies and approved program and delivery order requirements. Additionally he/she determines the need for an item or service, the Company's related specifications and the date required.

4.1.2 The PQAM or PQAS is responsible for reviewing and verifying the procurement requisition (PR) (Attachment 6.1), statements of work, subcontract, request for bid, and applicable technical and quality specifications are in compliance with the program/project quality requirements.

4.1.3 The Project Contract Manager (PCM) is responsible for the review of PRs to verify that all technical, quality and procurement requirements for the items or services to be supplied are included and have been approved by the responsible managers. The PCM identifies prequalified vendors, solicits competitive bids required, prepares the procurement documents, obtains the authorized signature for the expenditure of funds and completes the procurement transaction. Additionally he/she is responsible for numbering, logging and revising procurement documents as required to maintain traceability and current information.

4.2 Procurement Document Control

4.2.1 Procurement documents issued by the Contractor including bid requests, purchase requisitions, purchase orders, and contracts will be prepared, reviewed, and approved in accordance to contractor company policies. Purchase requisitions will be prepared by the individual requesting the item or service. Once the procurement requisition (PR) or procurement documents have been approved by the Project Manager, the PQAM or PQAS will review it for quality requirements prior to its initiation.

4.2.2 Procurement documents will state the applicable requirements for technical performance, quality acceptability, and documentation, as appropriate. Technical performance requirements may include:

- General requirements
- Scope of work
- Personnel qualifications
- Necessary licenses or permits
- Pertinent regulations and standards

- Material composition and/or physical and chemical requirements
- Type
- Composition
- Grade
- Properties
- Site/Volume
- Packaging
- Handling
- Shipping
- Storage
- Quantity required milestones, holdpoints, and scheduling
- Work procedures
- Testing and calibration requirements
- Test/calibration requirements
- Frequency
- Environmental conditions
- Performance and acceptance criteria.

4.2.3 Technical requirements will either be directly included in the procurement documents or referenced to specific drawings, specifications, statements of work, procedures, or regulations (along with specific revision numbers and issue dates) that describe the items or services to be furnished.

4.3 Procurement Requisitions

4.3.1 A PR is filled out by the individual requesting the item or service in accordance with the instructions provided on the back of the PR Form (Attachment 6.2). The instructions will include all the technical, quality and performance requirements to be met. A completed and approved PR is submitted to the PCM for the preparation of the appropriate procurement document. PRs are controlled by numbering, logging, and revision by the PCM.

4.3.2 The Project Manager will review the PRs for completeness and accuracy. The PQAM or PQAS will then review the PR prior to its initiation. The PR reviews will be to determine if as a minimum:

- The item(s) requisitioned are required for the project.
- The item(s) requisitioned meet or exceed the contract technical, quality and performance requirements.
- The required certifications, licenses, tests and measurements, permits and submittals are identified.
- The requested delivery date is at the appropriate date according to production schedule.
- Once the review is completed, the Project Manager will sign and date the PR and forward it to the PQAM or PQAS.

4.3.3 Upon receipt of the PR, the PQAM or PQAS will verify that it is properly completed and approved by the project manager. The PQAM's or PQAS's review may also include but not be limited to the following:

- The authorized signature/date approved block is signed and dated by the project manager.
- Sufficient description of materials, equipment or services is provided and verified against the technical specification.
- Referenced/required attachments are included.

- Technical/quality requirements are passed down to all lower tier suppliers and subcontractors.
- Applicable QC program requirements are included.
- Required technical and quality documentation that must be submitted prior to acceptance and completion of the work is specified.
- Applicable inspection and testing requirements needed to establish proper performance of the item or services is specified.

All comments, discrepancies, and approvals will be returned for correction and forwarded. Discrepancies noted outside of the technical/quality scope should be brought to the attention of the appropriate personnel, but will not affect QC acceptance of the PR.

4.3.4 Upon receipt, the PCM will initiate the appropriate procurement document in accordance with Company procurement policies, procedures, government regulations, and orders.

4.3.5 Procurement Documentation Revision

4.3.5.1 Revision(s) to procurement documents which have been issued will be initiated using the same method as the original procurement and will be accomplished using the following considerations:

- Determination of any additional or modified design criteria.
- Appropriate requirements as identified in paragraph 4.2 are identified or modified.
- Evaluations of exception(s) or change(s) requested by the subcontractor or supplier and the effect of those changes on the procurement activity. When revisions are required to increase quantities or to extend performance time, verify that Project Manager concurs with the need for increased quantities or an extended period of performance.

4.3.6 Control of Purchased Items and Services

4.3.6.1 A field quality check will be performed prior to commencement of the subcontracted activities. The PQAS will initiate the three phases of control as identified in the QAPP.

If, during the performance of the field quality check, deficiencies are noted, the PCM will be notified and corrective actions completed prior to their commencement of work.

4.3.6.2 For items and materials, a receipt inspection will be performed in accordance with SQP 7.2 by the QA staff prior to release or use.

5.0 RECORDS

Records generated as a result of implementing this SQP will be controlled and maintained in the project files in accordance with SQP 4.2.

6.0 ATTACHMENTS

Procurement Requisition

Instructions for completing the Procurement Requisition Form

Other forms may be substituted for the attached forms if the substituted forms contain similar information as the proposed attachments and have been approved for use by the

ATTACHMENT 6.1

PROCUREMENT REQUISITION

[Form(s) on Following Page(s)]

WEISS ASSOCIATES
PURCHASE/SERVICE ORDER

IMPORTANT: Mark all packages, correspondence and invoices with Purchase Order Number.

DATE OF ORDER «date_issued»	CONTRACT NO. *(IF ANY)* «Contract_»	Weiss Associates, «requestor_info»
PURCHASE ORDER NO. «JOB_»«PO»		5801 Christie Ave., Suite 600
POINT OF CONTACT/PHONE NO. «Sub_contact» / «sub_phone» / «sub_fax» fax		Emeryville CA 94608
COMPANY NAME «Sub»		
STREET ADDRESS «Sub_address»		TYPE OF ORDER ☑ PURCHASE/SERVICE REFERENCE «Sub» quote dated «quote_date» ☐ b. RENTAL
CITY «sub_city»	STATE «sub_state» / ZIP CODE «sub_zip»	

DELIVER/PERFORM ON OR BEFORE *(Date)*	PAYMENT/DISCOUNT TERMS	
«job_date»	☐ Net 60 ☐ Net 45 ☐ Net 30	☐ Net 15, _____% discount ☐ Within _____ days after Client pays Weiss ☐ Other ______________________________

SCHEDULE

ITEM NO.	SUPPLIES OR SERVICES	QUANTITY ORDERED	UNIT	UNIT PRICE	AMOUNT
0001	«SOW» Services shall be performed in accordance with «Sub» quotation of «quote_date» (attached). Attachments to this Purchase Order: (A) Terms and Conditions (B) «Sub» quote of «quote_date»		«quantity_»		«Amount»

PURCHASE ORDER ACCEPTANCE: By signing here constitutes acceptance by Subcontractor of this Purchase Order. Failure to sign this Purchase Order may result in delays in processing invoices.

Signature:___________________________________ Date:_____________

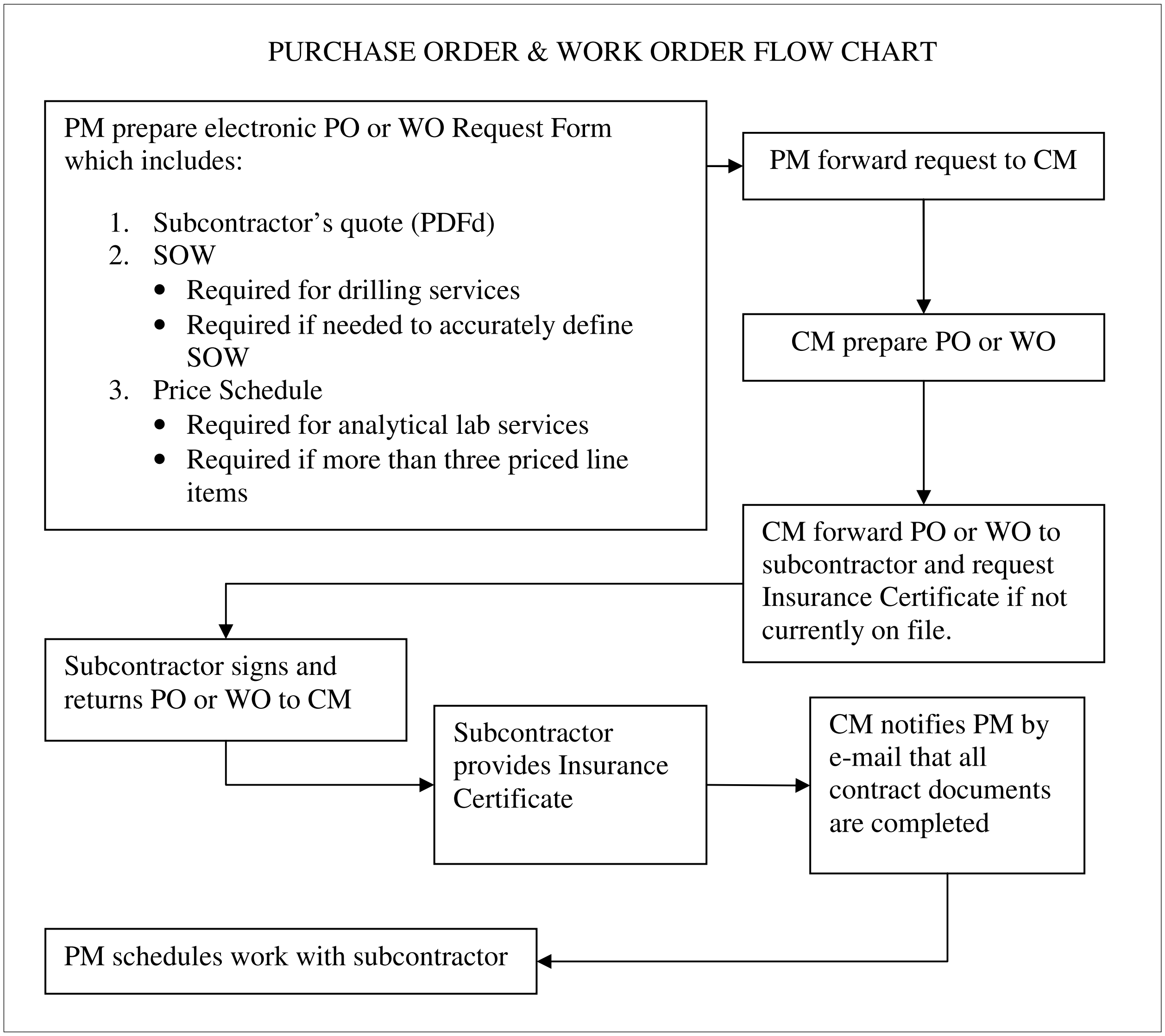
Subcontractor is not authorized to commence work until Weiss Associates receives a signed Purchase Order. Subcontractor will perform at its own risk if services are performed without a signed Purchase Order.

INVOICE SECTION: MAIL INVOICE TO: NAME Weiss Associates, Attn: Accounts Payable		**MODIFICATIONS**
STREET ADDRESS (or P.O. Box) 5801 Christie Avenue, Suite 600, M/S 2000 CITY Emeryville STATE CA ZIP CODE 94608	**Not-to-Exceed «Amount»**	**GRAND TOTAL**
AUTHORIZED BY *(Signature)*:	NAME *(Typed)* Gail M. McKay TITLE: Contracts Manager	

ATTACHMENT 6.2

INSTRUCTIONS FOR COMPLETING THE PROCUREMENT REQUISITION FORM

A Purchase Order (PO) contains full text of the applicable terms and conditions but not to the extent of a subcontract. PO's are in different formats for different services: (1) subconsultant services; (2) field services; (3) surveying, (4) drilling and (5) laboratory analysis. Also, for some clients, some prime terms and conditions must be "flow down" to the subcontracts. The process of issuing a PO is shown in the figure below. .



Purchase/Work Order Chart

QUALITY INSPECTIONS AND INSPECTION RECORDS

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for the performance and documentation of Quality Control (QC) inspection of activities performed during project activities to ensure compliance with established requirements.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan (QAPP)*

2.2 *SQP 4.2 - Records Management*

2.3 *SQP 10.1 - Nonconformance Control*

3.0 DEFINITIONS

3.1 Inspection

Examination or measurement to verify whether an item or activity conforms to specified requirements.

4.0 PROCEDURE

4.1 Qualification of Inspectors

4.1.1 Personnel performing inspection activities will have the necessary expertise in the area to be inspected, but will be sufficiently independent of the activity performed.

4.1.2 Prior to performance of inspection activities, personnel designated for that responsibility will review and be thoroughly familiar with the procedures, regulations, etc., governing the activities to be inspected.

4.2 Field Inspection Plans and Reports

4.2.1 Project activities requiring inspection (i.e., Preparatory Phase, Initial Phase and Follow-up Phase) will have an Items to Inspect Checklist (Attachment 6.1) prepared for that activity. Inspections will be performed for definable features of work which are identified for each task and will be performed consistent with ongoing project activities. Preparation Phase Inspections will not be conducted on tasks requiring Readiness Reviews (SQP 3.3) as the Readiness Review will serve as a Preparatory Phase Inspection.

4.2.2 The Items to Inspect Checklist will identify the items and activities to be inspected. If hold points are required, the Items to Inspect Checklist will identify them and indicate required notifications and sign-offs. The Project Manager and PQAM will limit the number of items to inspect to ensure that undue inspection activities are not spent on smaller tasks.

4.2.3 If a Nonconformance Report (SQP 10.1) is required for activities being inspected, a reference will be provided on the Contractor QC Report (Attachment 6.2).

4.2.4 The Contractor QC Reports will be issued identifying inspections performed. The report will be completed by the Project QA Specialist (PQAS) and will address each inspection performed during the course of the daily activities.

4.2.5 Items or activities not conforming to inspection acceptance criteria will be resolved and, when determined necessary, documented on a Nonconformance Report (SQP 10.1). Contractor QC Reports will be logged and sequentially numbered by project task. Each Contractor QC Report will be signed by the PQAS certifying that the activities listed within the report have been completed in accordance with the project planning documents to the best of his/her knowledge.

5.0 RECORDS

Records generated as a result of this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Pre-phase Inspection Checklist

6.2 Weekly Contractor Quality Control Report

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

PRE-PHASE INSPECTION CHECKLIST

Pre-phase Inspection Checklist

Task Name: ____________________

Task Number: ____________________

Scope: ____________________

Anticipated Field Work Dates: ____________________

Authorization from Task Leader: ____________________

Action Items	N/A	Yes	Verification/Date	No	Remedy/Date
Notifications					
Affected LEHR Facility Occupants/Operations Notified	N/A	Yes		No	
Project Documents					
Work Plan is on-site	N/A	Yes		No	
Quality Control Plan is on site	N/A	Yes		No	
Health and Safety Plan is on-site	N/A	Yes		No	
Emergency Response Plan is On-site	N/A	Yes		No	
Waste Management Plan and SOPs	N/A	Yes		No	
AHA and/or ALARA Evaluation	N/A	Yes		No	
Personnel Training					
Personnel has been trained with and acknowledge Project Documents	N/A	Yes		No	
Site briefing	N/A	Yes		No	
40 hour OSHA completed	N/A	Yes		No	
8 hour OSHA refresher completed	N/A	Yes		No	
Rad Worker II completed	N/A	Yes		No	
Medical Clearance completed	N/A	Yes		No	
Bioassay Submitted	N/A	Yes		No	
Whole Body Count Completed	N/A	Yes		No	
Contingency Plan and GERT Training	N/A	Yes		No	
Permits					
USA clearance	N/A	Yes		No	
UC clearance	N/A	Yes		No	
Excavation Permit	N/A	Yes		No	
Hazardous Work Permit	N/A	Yes		No	
Subcontractors					
Contracts complete	N/A	Yes		No	
Scheduled for work	N/A	Yes		No	
Subcontractor briefed on projects, documents, and procedures	N/A	Yes		No	
General					
Daily field logs	N/A	Yes		No	
Alconox	N/A	Yes		No	
Decon brushes	N/A	Yes		No	

Pre-phase Inspection Checklist

Action Items	N/A	Yes	Verification/Date	No	Remedy/Date
Decon sprayer	N/A	Yes		No	
Decon containers	N/A	Yes		No	
Distilled water	N/A	Yes		No	
Poly sheeting	N/A	Yes		No	
Drums/Drum labels	N/A	Yes		No	
Camera	N/A	Yes		No	
Weather (hot/cold, wet/dry)	N/A	Yes		No	
Sampling Equipment and Supplies					
Sampling plan	N/A	Yes		No	
Sample collection log	N/A	Yes		No	
Drill rig	N/A	Yes		No	
Support vehicles	N/A	Yes		No	
Sampling device	N/A	Yes		No	
Hand auger and extensions	N/A	Yes		No	
Hand trowel	N/A	Yes		No	
Ziploc bags	N/A	Yes		No	
Paper towels	N/A	Yes		No	
Sample containers	N/A	Yes		No	
Sample labels	N/A	Yes		No	
Shipping containers	N/A	Yes		No	
Sample packing supplies	N/A	Yes		No	
Shipping documentation	N/A	Yes		No	
Chain of Custody	N/A	Yes		No	
Fixed lab contacted/contact	N/A	Yes		No	
On-site lab	N/A	Yes		No	
Earthwork Equipment and Supplies					
Loader	N/A	Yes		No	
Dump Truck	N/A	Yes		No	
Stockpile Area	N/A	Yes		No	
Dust suppression equipment	N/A	Yes		No	
Fuel	N/A	Yes		No	
Trench plate and/or protection fence	N/A	Yes		No	
Nuclear density gauge	N/A	Yes		No	
DOE source authorization	N/A	Yes		No	
Operator training certification	N/A	Yes		No	
Straw bales	N/A	Yes		No	
HDPE	N/A	Yes		No	
Track-mounted hydraulic backhoe	N/A	Yes		No	
Wheel-mounted hydraulic backhoe	N/A	Yes		No	
Trench compactor	N/A	Yes		No	
Geotechnical lab contacted/contact	N/A	Yes		No	
Shoring	N/A	Yes		No	
- Hydraulic fluid	N/A	Yes		No	
- Installation/removal tools	N/A	Yes		No	
- Hydraulic pump	N/A	Yes		No	
Waste Management					
Waste stockpile areas	N/A	Yes		No	
Waste sorting equipment	N/A	Yes		No	
Waste shipping containers	N/A	Yes		No	
Shaker screen	N/A	Yes		No	
Hand tools					

Pre-phase Inspection Checklist

Action Items	N/A	Yes	Verification/Date	No	Remedy/Date
- Rakes	N/A	Yes		No	
- Hoes	N/A	Yes		No	
Gaskets for B-25s	N/A	Yes		No	
B-25 liners	N/A	Yes		No	
Postings/signage	N/A	Yes		No	
Waste inventory logs	N/A	Yes		No	
Waste container inspection	N/A	Yes		No	
Box labelling material	N/A	Yes		No	
Waste storage container	N/A	Yes		No	
- Drum	N/A	Yes		No	
- Bucket	N/A	Yes		No	
- B-25	N/A	Yes		No	
- Other	N/A	Yes		No	
<u>Health and Safety</u>					
Tailgate Safety meeting	N/A	Yes		No	
Hazards/HAZARDOUS WORK PERMIT posted	N/A	Yes		No	
PID onsite/calibrated	N/A	Yes		No	
First Aid Kit	N/A	Yes		No	
PPE (tyveks, gloves, booties, steel-toed boots)	N/A	Yes		No	
TLD/finger ring	N/A	Yes		No	
Eye protection	N/A	Yes		No	
Air horn	N/A	Yes		No	
Eye wash	N/A	Yes		No	
Fire Extinguisher	N/A	Yes		No	
Drinking water	N/A	Yes		No	
Perimeter established	N/A	Yes		No	
Heat stress Monitoring	N/A	Yes		No	
Work zone air monitoring	N/A	Yes		No	
Perimeter air monitoring	N/A	Yes		No	
Respirator	N/A	Yes		No	
Air horn	N/A	Yes		No	
<u>Radiological Equipment</u>					
Ludlum 2121 Smear Counter	N/A	Yes		No	
Ludlum 3 44-9 Equipment Frisking Beta-Gamma	N/A	Yes		No	
Ludlum 177, 44-9 Personnel Frisking Beta-Gamma	N/A	Yes		No	
High volume air sampler	N/A	Yes		No	
Rad equipment calibrated	N/A	Yes		No	
LSC	N/A	Yes		No	

Pre-phase Inspection Checklist

Action Items	N/A	Yes	Verification/Date	No	Remedy/Date
<u>Chemical and/or Physical Equipment</u>					
PID	N/A	Yes	______	No	______
O_2 monitor	N/A	Yes	______	No	______
______	N/A	Yes	______	No	______
______	N/A	Yes	______	No	______
______	N/A	Yes	______	No	______

Attachments

Readiness Review Checklist Completed by:

____
Weiss Associates Date

____
IT Corporation Date

____
ITEH Facility Authorization Date

ATTACHMENT 6.2

WEEKLY CONTRACTOR QUALITY CONTROL REPORT

WEEKLY CONTRACTOR QUALITY CONTROL REPORT

(Attach additional sheets if necessary)

Report No. ______________

Date Filled Out. __________

Dates this Weekly Report covers: ___________________________________

Summary of Weeks Activities:

____
____
____
____
____
____

Nonconformance/Corrective Actions identified this Week:

NCR/CAR #	Status of Nonconformance/Corrective Actions for the week/Outstanding from previous Weekly Report

Field Work Variances Created this Week that effect the Quality:

FWV #	Status of Field Work Variances for the Week that effect Quality

PQA Specialist Remarks:

____
____
____
____
____
____
____

I certify that this report is complete and correct, and that equipment and material used and work performed during this reporting period are in compliance with the contract drawings and specifications, to the best of my knowledge, except as noted in this report.

____

PQA Specialist Date

RECEIPT INSPECTION

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for the performance and documentation of receipt inspections of quality affecting items. These items are to be used or installed during project activities to ensure compliance with established requirements. Receipt inspection of items purchased to support field activities (i.e., gloves, heavy equipment, hand tools) will in general be conducted by the requestor and will verify the type and number delivered.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan (QAPP)*

2.2 *SQP 3.2 - Indoctrination and Training*

2.3 *SQP 4.2 - Records Management*

2.4 *SQP 7.1 - Quality Inspections and Inspection Records*

2.5 *SQP 10.1 - Nonconformance Control*

3.0 DEFINITIONS

3.1 Inspection

Examination or measurement to verify whether an item or activity conforms to specified requirements.

3.2 Inspector

A person who performs inspection.

3.3 Requestor

A person who requests a purchase requisition.

3.4 Item

An all-inclusive term used in place of any of the following: appurtenance, facility, sample, assembly, component, equipment, material, module, part, structure, subassembly, subsystem, system, unit, documented concepts, or data.

3.5 Supplier

(1) Any individual or organization that furnishes items in accordance with procurement documents.

(2) An all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, consultant, and their subtier levels.

3.6 Procurement Document

Purchase order, subcontract, micro-purchase order (verbal), drawings, specifications, or instructions used to define requirements for purchase.

4.0 PROCEDURE

4.1 Qualification of Inspectors

4.1.1 Personnel performing receipt inspection activities will have knowledge of the item to be inspected and its application to the work being performed. If an individual is not completely knowledgeable of the item, additional inspectors will be assigned by the Project QA Specialist (PQAS) to inspect the items.

4.1.2 The PQAS will assure performance of receipt inspections by qualified personnel for site specific items. Alternate inspectors may be designated by the PQAS based on their specialized technical expertise or familiarity with the items to be inspected.

4.2 Inspection Preparations

4.2.1 After a purchase requisition is processed, the Contracts Administrator will prepare and forward a copy of the applicable procurement document for receipt inspection to the requestor. The inspector will review the procurement documents and item specifications and, upon receipt of the item, ensure the item meets the requirements of the procurement documents. The inspector will also verify compliance with the Buy America Act requirements.

4.2.2 The supplier will provide the item as described in the procurement document. Any variation to the procurement document will require the same level of review and approval as the original procurement.

4.2.3 Items arriving at the project site will be routed to a designated receiving area. The recipient shall notify the requestor of its arrival and readiness for inspection.

4.3 Inspection

4.3.1 At the discretion of the Project Manager (PM) or PQAM, the inspector will conduct a receipt inspection of items designated to be consumed or permanently installed at the site. If the item is rejected, the basis for rejection will be documented on the Receipt Inspection Report (Attachment 6.1) and indicated on the shipper's receipt document. The PM and Contracts Administrator will be notified when an item is rejected. No items will be returned to a supplier without prior authorization of both the Project Manager and the Contracts Administrator.

4.3.2 The inspector will compare the shipping document (packing slip, weighmaster's certificate, etc.) with the procurement documents and note any discrepancies. When a minor discrepancy is identified, the PQAS will notify the PTL), who will resolve the issue with the supplier.

4.3.3 The inspector will visually inspect the item for physical damage and compliance to procurement documents requirements. The inspection of items will not include operational, performance or item applicability. If the item meets the procurement document requirements and no visual deficiencies are observed, the inspector will document acceptance on the Receipt Inspection Report and release the item for use. If the item is unacceptable, the inspector will notify the PQAS who will determine if the item should be accepted or rejected. If the item is rejected, the requestor will immediately notify the PTL and PM.

4.3.4 When the supporting documentation (i.e., catalog cuts, performance specifications) is not provided, and if the item meets the procurement document requirements, the PQAS will issue a conditional release for the item. The conditional release is temporary and allows management use of the item contingent on future receipt of the missing documentation in a timely manner. If requests for documentation are non-responsive, the conditional release will be revoked and the PQAM and the PTL will be notified. They will then consult with the Project Manager and Contracts Administrator and resolve the issue in question. Items conditionally released will be tracked on the Conditional Release Tracking Log (Attachment 6.2) by the PQAM until closure.

4.3.5 After an item is inspected and approved for use, the item will be released for use. The item will be stored in a secure area in a manner which protects its physical and operational characteristics from damage, deterioration or tampering.

5.0 RECORDS

Receipt inspection will be documented using the Receipt Inspection Report. A copy of the Receipt Inspection Report will be forwarded to the Contracts Administrator.

Records generated as a result of this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Receipt Inspection Report

6.2 Conditional Release Tracking Log

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

RECEIPT INSPECTION REPORT

RECEIPT INSPECTION REPORT

Date Received: ______________________ Vendor: ______________________

Date Inspected: ______________________ Item Description: ______________________

Procurement Document No.: ______________ Volume/Quantity/Duration: ______________________

Acceptance Criteria	Yes	No	N/A
Does the item or service meet the specifications shown in the procurement document?			
Does the item or service match the description listed on the vendor receipt? Verify quantities for each item/service.			
Have all required parts or documents been received, or have all services been performed? If no, contact the Project Quality Assurance Manager to make a conditional release determination.			
Does the procurement document require notification of the Property Manager? If yes, notify the Property Manager immediately and record the product serial number. Serial No.:			
Is the item free of defects or damage, or has the service been performed satisfactorily?			

Remarks: ____

____

____

The above-noted item or service is acceptable for release.

Inspector Name (print)	Inspector Signature	Date

The above-noted item has been received or the above-noted service has been performed.

End-User Name (print)	End-User Signature	Date

When complete, attach to the procurement document and distribute copies to the inspector, the Property Manager (if notification is required), and the Contracts Administrator (Receipt Inspection Report only). The original will be kept in the field procurement file.

ATTACHMENT 6.2

CONDITIONAL RELEASE TRACKING LOG

ATTACHMENT 6.2

CONDITIONAL RELEASE TRACKING LOG

Project Description: ______________________ Task Name: ______________________

Item No.	Item Description	Vendor Name	P.O. Number	Release Restriction	Date Identified	Date Required	Date Received/ Closed	Remarks

CALIBRATION AND MAINTENANCE OF MEASURING AND TEST EQUIPMENT

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities associated with the calibration, control, and maintenance of measuring and test equipment (M&TE). It applies to all tools, gauges, instruments, and other test equipment where the manufacturer requires or recommends equipment accuracy to be checked periodically. In the case of commercial devices such as rulers, tape measures, and levels, calibration controls will not be required.

2.0 REFERENCES

2.1 Quality Assurance Project Plan

2.2 SQP 4.2 - Records Management

3.0 DEFINITIONS

3.1 M&TE

Measuring and test equipment used to obtain data during the performance of tests or inspections.

3.2 Calibration

The comparison of a measurement standard or instrument of a known accuracy with another standard or instrument to detect, correlate, report, or eliminate by adjustment, any variation in the accuracy of the items being compared within allowable deviations.

3.3 Reference Standard

An item of known and verifiable value which is used to check or establish the basis for tests or inspections.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The Project Task Leader (PTL) is responsible for assuring that M&TE used in activities affecting quality is calibrated and properly adjusted or replaced at specific periods or use intervals to maintain accuracy within necessary limits. He/she will also ensure implementation of this procedure and provide adequate facilities to store and maintain the M&TE.

4.1.2 The PQAS is responsible for monitoring the effective implementation of this SQP and/or the M&TE manufacturer's recommendations.

4.1.3 The PTL is responsible for the selection of M&TE to be used in the field activity and to assure it is of the proper type, range, accuracy and tolerance required to meet project objectives. Additionally, he/she is responsible for storage and protection of M&TE.

4.1.4 The field personnel performing tests are responsible for assuring that all M&TE is properly calibrated prior to and during use, and for documenting the calibration or deficiencies of equipment.

4.2 Equipment Identification and Control

4.2.1 M&TE that requires calibration will be uniquely identified by the manufacturer's serial number, or other suitable assigned number. If this should prove to be impractical, an identification label will be affixed using materials and methods which provide a clear and legible identification and do not detrimentally affect the function or service life of the M&TE. This identification will be replaced as needed to provide clear identification of the M&TE.

4.2.2 All M&TE and reference standards shall be stored between uses in a manner that will minimize damage or deterioration.

4.3 Calibration

4.3.1 Written and approved procedures will be used for calibration of M&TE. Calibration procedures that have been previously established and approved by the M&TE manufacturer or a nationally recognized authority (i.e., ASTM, EPA) will be used when available. If no preexisting procedure is available, procedures will be developed by qualified personnel familiar with the M&TE and approved by the Project Manager and PQAM. Development of procedures will take into consideration the intended use and objective of the resulting data, equipment characteristics, required accuracy and precision of data, location of examination, effects of climate or any other parameter which would adversely influence the calibration. The procedures will include, as applicable:

- Name/type of equipment to be calibrated
- Reference standards to be used
- Calibration method and sequential actions

- Acceptance criteria
- Frequency of calibrations/checks
- Data recording form/format
- Data processing methodology
- Any special instructions
- Operator training and qualification requirements.

4.3.2 Field M&TE will be calibrated prior to use. Calibrations of M&TE will be performed by trained and qualified personnel, approved external agencies or by the equipment manufacturer.

4.3.3 The following types of calibrations and checks will be performed by qualified personnel:

- Periodic calibrations - which are performed at prescribed intervals established for the M&TE to assure that the equipment is operating within its designed range and accuracy. These are usually performed by outside agencies or the M&TE manufacturer. A calibration certificate will be provided documenting the operational and functional acceptance of the M&TE.
- Specific calibrations - which are performed for specific measurements or tests and varies from instrument to instrument and from procedure to procedure. Specific calibrations are typically performed prior to start of each work shift.

4.4 Calibration Frequency

4.4.1 M&TE will be calibrated at prescribed intervals and before each specific use. The frequency of periodic calibrations will be based on manufacturer's recommendations, national standards of practice, equipment type and characteristics, and past experience.

4.4.2 Scheduled calibrations of M&TE does not relieve the user of the responsibility for selecting the appropriate and properly functioning equipment.

4.4.3 In the event that the calibration has expired, the M&TE will be removed from service and tagged as "out-of-service" to prevent inadvertent use until it has been appropriately recalibrated.

4.5 Reference Standards and Equipment

4.5.1 Calibration reference standards and equipment will have known relationships to the National Institute of Standards and Technology (NIST) or other nationally recognized standards. If a national standard does not exist, the basis for calibration will be fully documented by the PTL and approved by the Project Manager and PQAM.

4.5.2 Physical and chemical standards will have certifications traceable to NIST, EPA or other recognized agencies. Standards that are repackaged or split will also have traceable lot or batch numbers transferred onto the new container.

4.5.3 It is the responsibility of the user to select, verify and use the correct standard in accordance with an approved procedure or established practice.

4.6 Calibration Failure

4.6.1 Each individual user of M&TE is responsible for checking the calibration status of equipment to be used and confirming the acceptable calibration status prior to use. Equipment for which the periodic calibration period has expired, equipment that fails calibration, or equipment that becomes inoperable during use will be removed from service and tagged as out-of-service.

4.6.2 Out-of-service M&TE will be segregated from operational M&TE when practical. The specific reason for removal from service and the date of removal will also be stated on the out-of-service tag. The M&TE will then be repaired and/or recalibrated by the appropriate vendor or manufacturer as deemed necessary by the PTL or the Project Manager. M&TE that cannot be repaired will be replaced, as necessary, to provide support to the project. Any M&TE consistently found to be out-of-calibration will be replaced.

4.6.3 Results of activities performed using equipment that has failed recalibration will be evaluated by the PTL and/or Project Manager and approved by the PQAM. If the activity results are adversely affected, the results of the evaluation will be documented as a nonconformance.

4.7 Calibration Documentation

4.7.1 Specific calibration records will be prepared and documented for each calibrated M&TE used. Periodic calibration certificates will be maintained and available for review at the field office. Calibration data will be recorded on the Test Equipment List and Calibration Log form (Attachment 6-1) or other suitable form. The Project Task Leader will be responsible for reviewing the calibration data for appropriateness, accuracy, readability, and completeness.

4.7.2 Calibration records will include, as applicable, the following information:

- Equipment identification number;
- Calibration procedure used;
- Date/time of calibration;
- Time of calibration checks (if required);
- Identification of reference standard(s) used;
- Applicable responses or readings of calibration;
- Name of individual performing calibration; and,
- Item(s) that are being tested or inspected.

4.8 Preventive Maintenance

4.8.1 Preventive maintenance of M&TE will be performed in accordance with manufacturers recommendation to maintain proper M&TE performance, minimize equipment failure and to increase measurement reliability.

5.0 RECORDS

The records generated as a result of implementing this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Test Equipment List and Calibration Log

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

TEST EQUIPMENT LIST AND CALIBRATION LOG

TEST EQUIPMENT LIST AND CALIBRATION LOG

Equipment Number and Use (Screening or Analytical)	Equipment Name (Manufacturer and Model ID)	Date and Time of Calibration	Calibration Standard Used (Manufacturer and Lot Number)	Equipment Rating (include Units and Tolerance)	Comments/Observations	Calibrator's Initials

Note: Complete calibration and record information before use for all test equipment that requires calibration.

CONTROL OF TESTS

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and controls to ensure that performance of testing activities that affect quality are performed according to contract requirements and specifications, and are routinely checked for performance and deficiencies.

2.0 REFERENCES

Quality Assurance Project Plan

SQP 3.2 - Indoctrination and Training

SQP 4.2 - Records Management

SQP 8.2 - Calibration and Maintenance of Measuring and Test Equipment

SQP 10.1 - Nonconformance Control

SQP 10.2 - Corrective Action

3.0 DEFINITIONS

3.1 Quality Affecting Activity

An activity that determines the validity of reported information or data, that assesses the risk to environmental health or safety of the public, or that could substantially impact the objectives of the delivery order.

3.2 Checks

The tests, measurements, verifications, or controls placed on an activity that affect quality todetermine acceptable condition, accuracy, or performance.

3.3 Qualified Procedures

A method or technique designated in the project task contract for a particular quality affecting activity.

3.4 Testing Plan and Log

A tabulated format illustrating the qualified procedures for a corresponding quality affecting activity. The plan typically identifies the items to be tested, the tests to be performed, test sequences, personnel requirements, and evaluation criteria.

4.0 PROCEDURE

4.1 Test Personnel/Facility Qualification

4.1.1 Personnel or facilities involved in laboratory, field, and materials analysis will have the appropriate credentials and training on record in accordance with SQP 3.2. The appropriate credentials and training will be identified in the Statement of Work which procures the testing or service.

4.2 Test Plan and Log

4.2.1 Project test requirements will be identified in the scope of work, Work Plan and/or Sampling and Analysis Plan, and Test Plan and Log, with the corresponding qualified procedure. The person or facility qualified to perform the test will also be identified. The Test Plan and Log will include:

- Test name
- Qualified procedure (ASTM, AASHTO, etc.)
- Frequency
- Specification paragraph number
- Responsible organization/personnel
- Accreditation of the laboratory or subcontractor

4.3 Calibration Requirements

4.3.1 Properly calibrated test equipment is essential in achieving quality data and meeting the objectives of the project task. Test equipment will be operationally checked and calibrations documented frequently based on the requirements of the instruments or equipment operating manual or industry standard, such as ASTM, EPA, and NIST, and in accordance with SQP 8.2. In addition, required routine maintenance will also be documented.

4.4 Quality Control Checks

4.4.1 The workplan Contract or project specifications shall establish the parameters or conditions to assure data precision and accuracy for laboratory and field measurements, and material inspections. Acceptance limits for the quality control checks shall be specified, and corrective actions shall be documented when established limits are exceeded as described in SQP 10.1 and 10.2.

4.5 Test Reports

4.5.1 Test reports for geotechnical, material, and analytical tests or inspections will be written atthe completion of that activity. The test report will be formatted in the following fashion:

- Applicable contract requirements, test methods and analytical procedures used
- Test results
- A statement from the facility certifying that the tests conform to the established test method requirements
- Signature of qualified test personnel from the facility, attesting the data or materials conform with the Contract, or task requirements or specifications.

4.6 Test Review

4.6.1 The PQAM will review test reports for conformance with the Contract, or project requirements or specifications. The PQAM will attest to whether the qualified procedure was performed accordingly. Test reports that conform will be stamped "CONFORMS." Test reports that do not conform will be stamped "DOES NOT CONFORM."

4.7 Nonconformance Control and Corrective Action

4.7.1 Conditions adverse to quality will be documented in accordance with SQP 10.1. The PQAM will issue a CAR which will illustrate the condition adverse to quality, the reference section or paragraph, and its frequency for reoccurrence in accordance with SQP 10.2. The CAR will be issued to the responsible party for resolution or explanation for the condition adverse to quality.

5.0 RECORDS

Test reports, certifications and qualifications documentation, NCRs, and CARs generated as a result of the implementation of this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Test Plan and Log

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

TEST PLAN AND LOG

[Form(s) on Following Page(s)]

NONCONFORMANCE REPORT

NCR Number:	Company:	Date:

Nonconformance Description (include specific requirement violated):

Identified By: Date:

Root Cause of Nonconforming Condition:

Corrective Action to be Taken (include date when action(s) will completed):

To be Performed By:_____________________________ Anticipated Completion Date:

Action to be Taken to Preclude Recurrence:

To be Performed By:_____________________________ Anticipated Completion Date:

Acceptance By:___________________________ Date:____________ Acceptance By:___________________________ Date____________
Project Manager PQA Manager

Corrective Actions Completed By and Date:	Verification Completed By and Date:

NONCONFORMANCE CONTROL

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the method and responsibilities for documenting and resolving technical or other quality related nonconformances which may not have been identified or resolved through assessments, inspections, or reviews.

2.0 REFERENCES

2.1 Quality Assurance Project Plan

2.2 SQP 4.2 - Records Management

2.3 SQP 10.2 - Corrective Action

3.0 DEFINITIONS

3.1 Nonconformance

A deficiency in characteristic documentation or procedure which renders the quality of an item unacceptable or indeterminate with respect to established criteria. Examples of nonconformances include, but are not limited to test failures, physical defects, incorrect or inadequate documentation, data losses, or deviations from prescribed work plan processes, inspections, or procedures.

4.0 PROCEDURE

4.1 Precautions

Nonconformances may be related to hazards or potential safety concerns that require expedient action to resolve or mitigate. When prompt action is required, that action should not be unduly delayed for the processing of a Nonconformance Report (NCR). However, action that mitigates or even resolves nonconformances does not eliminate the requirement for documenting the deficiency on a NCR.

4.2 Nonconformance Identification

Any individual assigned to a project, who discovers a nonconformance, is responsible for preparing a NCR to describe and document it. The individual completes the nonconformance description sections of the NCR/CA form (Attachment 6.1). The NCR will be accurately and concisely written after consultation with the interested parties to ensure that the discrepancy is correctly described, the appropriate project task criteria are referenced, and that sufficient data are provided to facilitate a proper and complete disposition for resolving the nonconformance. When this section of the NCR/CA form is completed, the report is sent to the PQAM for review. After this review is complete, the NCR/CA form is forwarded to the responsible organization for determining and documenting the appropriate disposition.

4.3 Segregating Nonconforming Items

Whenever practical, nonconforming items will be segregated from the conforming items by separated storage, clearly marked storage boundaries utilizing signs or roped off areas, or other appropriate means to prevent the inadvertent installation or use of the nonconforming items, or will be identified as nonconforming by the use of tags or markings.

4.4 Nonconformance Reporting

4.4.1 Potential nonconformances will be evaluated by the PQAM to assess the extent of nonconformance, the significance, and any potential impact on safety, waste isolation, or quality. This assessment will be performed with the assistance of the responsible engineering/construction discipline.

4.4.2 Nonconformances that are evaluated and determined to be conditions "significantly" adverse to quality will be documented and reported in accordance with SQP 10.2. The following guidelines will be used to determine "significant" conditions:

- Failure of the procedural system to produce the results desired in project deliverables.
- Identification of repetitive conditions for which previous corrective actions have proven ineffective.
- Repeated failure to comply with contract requirements, QAPP and procedures.
- Significant deficiencies found during the review or validation of data.

NOTE: Situations described above will require immediate notification of the Program or Project Manager and PQAM.

4.4.3 The client will be promptly notified of technical errors in work previously completed and transmitted to them.

4.4.4 The Remedial Project Manager at the Environmental Protection Agency will be notified of conditions that require significant corrective actions within five working days of the determination that a significant corrective action is required.

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~~4.4.4~~4.4.5 The PQAM will maintain an NCR/CA status log (Attachment 6.2) of open and closed Nonconformance Reports. The Log will also serve as the basis for the NCR serial number system.

4.5 Nonconformance Resolution

The responsible organizational discipline will document the resolution of the nonconformance in the space provided on the NCR, or on additional sheets, as necessary. The resolution response will also describe the cause, the corrective action to be taken to resolve the condition, the measures to be taken to prevent recurrence of the nonconformance, the date when all actions will be completed, and will be signed by management of the organization responsible for the nonconformance.

4.6 Verification and Closeout

Resolution of nonconformances will be verified by the PQAM/PQAS. The nonconformance will not be closed until all corrective and preventative measures have been completed, or long-term corrective measures established and implemented.

5.0 RECORDS

5.1.1 Records generated as a result of implementation of this SQP will be retained for each NCR and will include the following:

- The initial notification which resulted in the NCR.
- The results of any technical evaluation.
- The original NCR/CA form issued with the appropriate resolution and signatures.
- Other pertinent information necessary to document resolution of the NCR, including scope and significance of the problem as applicable.

5.1.2 Records, upon closure of each NCR, will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Nonconformance Report/Corrective Action

6.2 Nonconformance Report/Corrective Action Log

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

NONCONFORMANCE REPORT/CORRECTIVE ACTION

NONCONFORMANCE REPORT/CORRECTIVE ACTION

NCR Number:	Company:	Date:

Nonconformance Description (include specific requirement violated):

Identified By: Date:

Root Cause of Nonconforming Condition:

Corrective Action to be Taken (include date when action(s) will completed):

To be Performed By:_________________________ Anticipated Completion Date:

Action to be Taken to Preclude Recurrence:

To be Performed By:_________________________ Anticipated Completion Date:

Acceptance By:____________________________ Date:_____________ Acceptance By:____________________________ Date_____________
Project Manager PQA Manager

Corrective Actions Completed By and Date:	Verification Completed By and Date:

ATTACHMENT 6.2

NONCONFORMANCE REPORT/CORRECTIVE ACTION LOG

NONCONFORMANCE REPORT/CORRECTION ACTION LOG

NCR/CA #	COMPANY	DATE NCR REPORTED	DATE NCR ACCEPTED	DATE CA IDENTIFIED	DATE CA COMPLETED AND VERIFIED

CORRECTIVE ACTION

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for documenting and resolving conditions "significantly" adverse to quality. These conditions require immediate management action or attention to resolve. Conditions adverse to quality, which are not determined to be "significant", shall be documented and reported in accordance with SQP 10.1.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan*

2.2 *SQP 4.2 - Records Management*

2.3 *SQP 10.1 - Nonconformance Control*

2.4 *SQP 10.3 - Stop Work Order*

3.0 DEFINITIONS

3.1 Conditions Adverse to Quality

An all-inclusive term used in reference to any of the following: failure to meet performance objectives, malfunctions, deficiencies, defective items, and nonconformance. A significant condition adverse to quality is one, which, if uncorrected, could have a serious effect on safety, operability or project performance.

3.2 Corrective Action

Measures taken to rectify conditions adverse to quality and, where necessary, to preclude repetition.

4.0 PROCEDURE

4.1 Corrective Action Identification

4.1.1 A Corrective Action will be initiated for those conditions adverse to quality which are evaluated and determined by the PQAM or PQAS to be "significantly" adverse to quality. The following guidelines will be used to determine "significant" conditions:

- Failure of the procedural system to produce the results desired in project deliverables.

- Identification of repetitive conditions for which previous corrective actions have been ineffective.
- Repeated failure to comply with contract requirements, QAPP, SQPs, SOPs and HSPs procedures.
- Significant deficiencies found during the review or validation of data.

4.2 Corrective Action Reporting

4.2.1 For Nonconformances determined to be significantly adverse to quality, the Corrective Action (CA) to be taken will be documented on the Corrective Action portions of the NCR/CA form (see SQP 10.1)

4.2.2 The PQAM will maintain an NCR/CA status log of open and closed corrective action requests. The log will also serve as the basis for the an NCR/CA serial number system.

4.2.3 The Remedial Project Manager at the Environmental Protection Agency will be notified of conditions that require significant corrective actions within five working days of the determination that a significant corrective action is required.

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4.3 Corrective Action Follow-up

4.3.1 The PQAM or PQAS will monitor the status of NCR/CAs and prepare correspondence relating to overdue responses. If a request for an extension of a response is received, an evaluation will be made and a formal response submitted to the requestor. All extensions to response due dates will be recorded in the NCR/CA log.

4.3.2 Failure to address Nonconformances that require CA will result in an evaluation of the condition to determine if a Stop Work Order (SWO) is warranted. Stop Work Order evaluation and determination will be conducted in accordance with SQP 10.3.

4.3.3 Implementation of CAs, will be verified by the PQAM or PQAS. The results of verification will be documented on the NCR/CA form and status log.

Upon completion (closeout) of the CA, the PQAM will then note it as closed in the NCR/CA log.

5.0 RECORDS

5.1.1 Records generated as a result of implementation of this SQP will be retained for each CA and will include the following:

- The original NCR/CA form along with all required corrective actions completed and all appropriate signatures.
- Any backup data necessary to substantiate the original condition noted in the NCR/CA form, the stated corrective action, evaluation, or verification.

- Overdue response notifications, requests for extension of response due dates, and replies to extension requests.

5.1.2 Records, upon closure of each CA, will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None (see Forms in SQP 10.1).

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

STOP WORK ORDER

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) describes the process and responsibilities for issuing, resolving, and verifying acceptable response/actions for Stop Work Orders (SWO). SWOs are limited to Contractor and subcontractor/vendor activities.

2.0 REFERENCES

2.1 Quality Assurance Project Plan

2.2 SQP 4.2 - Records Management

3.0 DEFINITIONS

3.1 Stop Work Order

The order issued to the Project Manager or responsible individual for subcontractor/vendor services to stop further processing, delivery, installation, or operation until proper disposition of a nonconformance, deficiency, or unsatisfactory condition has occurred.

3.2 Action Party

The manager or responsible individual to whom the Stop Work Order is issued.

4.0 PROCEDURE

4.1 Responsibilities

4.1.1 The PQAM or PQAS is responsible for issuing Stop Work Orders (SWO) when conditions warrant and for assuring corrective action is accomplished. The PQAM or PQAS will notify the Program Manager and/or Project Manager that a SWO condition exists as described in 4.2.1. The PQAM or PQAS will maintain a SWO log and the original SWO(s); perform verification that corrective action is complete and effective; and notify responsible management of closure for SWOs.

4.1.2 The Action Party is responsible for stopping work upon verbal notification from the PQAM or PQAS and for implementing the required corrective action.

4.2 Stop Work Order Criteria

4.2.1 The following criteria are utilized as a guideline for determining whether to issue a Stop Work Order:

- Continuing an operation will directly affect the integrity of the work or documentation which is required and would result in significant rework.
- Continuing an operation will jeopardize the integrity of design, the nonconformance will cause design discontinuities to other item or activities, or compromise the essential features which are important to programmatic objectives or safety.

4.3 Issuance of the Stop Work Order

4.3.1 Upon determination by the PQAM or PQAS that the criteria for issuing a SWO applies, the Program or Project Manager will be notified verbally or by memorandum that an SWO condition exists and that a stop work order will be issued.

4.3.2 The PQAM or PQAS will notify (written or verbal) the applicable Action Party of the intent to stop work, when the stop work is effective and to what activities the stop work applies.

4.3.3 The Program Manager or PQAM will notify the following personnel (as soon as practical) when an SWO is issued:

- Client Contracting Officer
- Client Project Manager
- Action Party

NOTE: This verbal notification will include all data available at the time of notification and will be followed up with a copy of the written confirmation.

4.3.4 The PQAM or PQAS will issue the written SWO, Attachment 6.1, as soon as practical, after verbal notice is given.

4.3.5 The Program Manager, Project Manager, and/or Project Task Leader, and PQAM and/or PQAS, and Action Party will coordinate, as necessary, a corrective action plan and a date for completion. The Program Manager, Project Manager, and/or Project Task Leader and PQAM and/or PQAS, will sign the SWO, signifying agreement with the corrective action required.

4.3.6 The PQAM or PQAS will forward a copy of the SWO to the Action Party. The original SWO will be maintained by the PQAM for logging the SWO on the Stop Work Order Log (Attachment 6.2). The original SWO will be maintained by the PQAM.

4.3.7 The Action Party will implement the required remedial action and notify the PQAM or PQAS when completed.

4.4 Stop Work Order Closure

4.4.1 Upon verification of satisfactory completion of remedial action, the PQAM or PQAS may verbally cancel the Stop Work Order by notifying the Program or Project Task Leader and obtaining concurrence.

4.4.2 The PQAM or PQAS will notify the Action Party that they may resume work.

4.4.3 The PQAM or PQAS will complete the SWO form, distribute copies, and forward the completed SWO to the project record files for retention.

5.0 RECORDS

5.1.1 Stop Work Orders and subsequent documentation, generated as a result of implementation this procedure will be controlled and maintained in the project record files in accordance with SQP 4.2.

5.1.2 The Stop Work Order Log is not a Project Record. The SWO Log will be maintained, as a minimum, until the end of the Project Task.

6.0 ATTACHMENTS

6.1 *Stop Work Order*

6.2 *Stop Work Order Log*

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

STOP WORK ORDER

STOP WORK ORDER

Company: ______________________ Location: ______________________

Date: ______________________

1. Written Notice Issued to:
   - Name: ______________________
   - Title: ______________________
   - Org.: ______________________
2. P.O. # or Activity: ______________
3. Location: ______________
4. Issued by (name): ______________
   Issued by (title): ______________

5. Verbal Notice Issued to:
   - Name: ______________________ Date: ____________ Time: ____________
   - Title: ______________________

6. Associated NCR No.: ______________ 7. Associate CAR No.: ______________

8. Stop Work Order Condition Description: Attachment: ______________

9. Remedial Action Required: Attachment ______________
   - By Whom: ______________________ By When: ______________________
   - Required Remedial Action Determined by:
   - Project Manager: ______________________ Date: ______________
   - PQA Manager ______________________ Date: ______________

10.Follow-up of Remedial Action Taken: Attachment: ______________

Verbal Notice to Resume Operations Given to:
   - Name: ______________________ Date: ____________ Time: ____________
   - Title: ______________________

Stop work Order Cancellation Authorized by:
   - PQA Manager: ______________________ Date: ______________

ATTACHMENT 6.2

STOP WORK ORDER LOG

STOP WORK ORDER LOG

Company:

SWO No.	Action Party/Organization	Subject	Date Issued	Date Closed

FIELD WORK VARIANCE/MODIFICATION

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities associated with the development and control of Field Work Variances (FWV) and Field Work Modifications (FWM).

2.0 REFERENCES

2.1 Quality Assurance Project Plan

2.2 SQP 4.2 Records Management

3.0 DEFINITIONS

3.1 Field Work Variance

A change to the performance of the work subject to the technical direction from the DOE Project Manager or Contracting Officer's Representative. Technical direction is defined as:

(1) Directions which redirect the contract effort, shift work emphasis between work areas or tasks, require pursuit of certain lines of inquiry, fill in details or otherwise serve to accomplish the contractual Statement of Work.

(2) Provision of written information, which assists in the interpretation of drawings, specifications or technical portions of the work description.

(3) Review and, where required, approval of technical reports, drawings, specifications and technical information to be delivered to the DOE under the contract.

(4) Technical direction must be within the scope of work stated in the contract.

Documentation of the Field Work Variance will be used to determine the necessity of requesting additional funding from DOE for the Task Assignment.

3.2 Field Work Modification

Changes which constitutes a Field Work Modification based on the following:

(1) Constitutes an assignment of additional work outside the Statement of Work;

(2) Constitutes a change as defined in the contract clause FAR 52.243-2, Changes-Cost Reimbursement (Aug 1987);

(3) In any manner causes an increase or decrease in the **total Task Assignment estimated cost**, or the time required for contract performance; and,

(4) Changes any of the expressed terms, conditions or specifications of the contract.

Only the DOE Contracting Officer has the authority to authorize a change. Work for a Field Work Modification should not commence without the written approval from the Contracting Officer.

3.3 Task Plan Revision

A Task Plan Revision is a modification to the cost proposal for a specific Task Assignment. The Task Assignment Revision is prepared by the WA Project Manager and submitted to DOE for negotiation, if necessary, and issuance of a Task Assignment Revision.

4.0 PROCEDURE

4.1 Discussion

Procedural or material changes may be required due to unforeseen events or assumptions based on limited data made during the development of plans, specifications and procedures. Worker input may also precipitate the need for change. To maintain and control project activities, changes must be documented and approved before their implementation. In general, changes will be documented through the use of a FWV/M form (Attachment 6.1) and tracked with a FWV/M tracking log (Attachment 6.2). The form should be completed in its entirety if the change affects the cost or schedule of work.

4.2 Responsibilities

4.2.1 The Project Manager (PM) has the overall responsibility for the implementation and effectiveness of the FWV/M system.

The PM is responsible for reviewing and approving Project Task FWV/M forms and obtaining quality review by the PQAM.

4.2.2 The Project Task Leader (PTL) is responsible for the initiation of the FWV/M Form and obtaining worker input on the proposed changes, as appropriate.

4.2.3 The Program Quality Assurance Manager (PQAM) is responsible for reviewing the FWV/Ms that affect quality and for monitoring FWV/Ms to verify effectiveness of the change control systems.

4.1.5 The Contract Manager is responsible for assisting the PM in ascertaining if the variance requires a Task Plan Revision and participates upon the PM request in any subsequent negotiations with DOE.

4.3 Implementation of Change

Attachment 6.2 is a flow-chart showing the Field Work Variance/Modification Process

4.3.1 Determination of need for FWV/M

4.3.2 When a FWV/M is needed, the Project Task Leader (PTL) shall verbally advise the PM of the change. Based on the information provided to the PM, a decision will be made as to what type a change is required, variance or modifications. The PTL will then prepare the FWV/M Form. The form will then be submitted to the PM for approval.

4.3.3 Field Work Variance

The PM shall obtain the PQAM review, if necessary, and will subsequently approve the FWV/M. A copy of the approved FWV/M will be provided to the DOE Contracting Officer's Representative and the DOE Project Manager for their information and files.

When approximately 75% of the Task Assignment costs have been expended, the PM will determine if the current estimated total cost of the Task Assignment is adequate to complete the work including all estimated costs of the variances. If a determination is made that additional funding is required, the PM will notify the DOE Contracting Officer's Representative and begin the Task Plan Revision process.

4.3.4 Field Work Modification:

The PM shall obtain the PQAM review and will subsequently approve the FWV/M.

The PM shall promptly request that the DOE Contracting Officer's Representative issue a Task Description authorizing the preparation of a Task Plan Revision. At this time the PM shall decide to issue a "stop work" order ending all effort pursuant to the Modification.

Upon receipt of the Task Description, a Task Plan Revision will be prepared and the instruction contained in Clause H.008, Ordering Procedure, of Contract DE-AC03-96SF20686 will be followed.

4.4 Preparation of FWV/M Forms

4.4.1 The PTL or designee will complete the FWV/M form. The FWV/M will clearly identify the present requirement (including section number), the proposed change, technical justification, cost and schedule impact (if needed), and documents requiring change.

4.4.2 Any requested change or deviation to contract requirements or plans will not be implemented until signed approval of the FWV/M is received from the PM .

4.5 FWV/M Tracking Log

The PTL or designee will maintain a FWV/M Tracking Log (Attachment 6.3) which will identify each item with a unique number, brief description, date of issue and status of the individual FWV/Ms

4.5.1 Document Distribution

A copy of the approved FWV/M Form shall be provided to the PTL and the Contracts Manager.

A copy of the FWV/M Tracking Log will be provided to the PM and the Deputy Project Manager when updated.

5.0 RECORDS

Records generated as a result of implementing this SQP will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Field Work Variance/Modification

Field Work Variance/Modification Procedure Flow Chart

6.2 Field Work Variance/Modification Tracking Log

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

FIELD WORK VARIANCE/MODIFICATION

FIELD WORK VARIANCE/MODIFICATION

Project No.: 128-4005	Date:	Variance No.:
Phase No:		☐ Task assignment revision required
Task Name:		Requested by:

PRESENT REQUIREMENTS:

PROPOSED CHANGE:

TECHNICAL JUSTIFICATION:

COST/SCHEDULE IMPACT: (not necessary for modifications)

ATTACHMENTS:

PQAM REVIEWED ________________________________ DATE: ___________

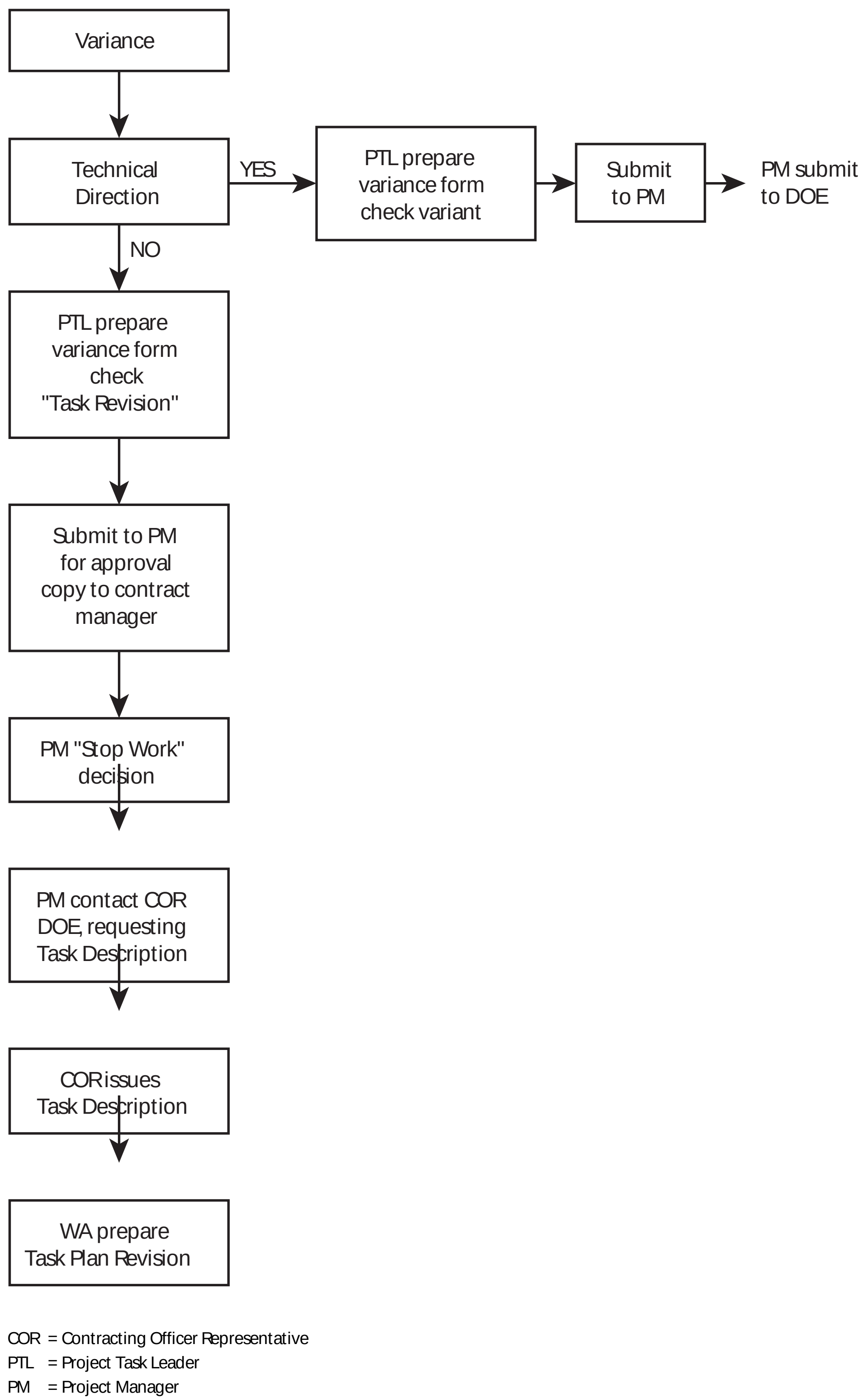
APPROVED BY ________________________________ DATE: ___________
Weiss Associates Project Manager

APPROVED BY ________________________________ DATE: ___________
DOE Contracting Officer Representative

If modification affects subcontractor (s), submit a copy of this form to the appropriate subcontractor (s)

ATTACHMENT 6.2

FIELD WORK VARIANCE/MODIFICATION PROCEDURE FLOWCHART



Attachment 6.2. Field Work Variance/Modification Procedure Flowchart

ATTACHMENT 6.3

FIELD WORK VARIANCE/MODIFICATION TRACKING LOG

FIELD WORK VARIANCE/MODIFICATION TRACKING LOG

PROJECT NO.:	DATE:	MODIFICATION NO:
PROJECT NAME:		

MODIFICATION DETERMINED BY (Name and Company) :

PRESENT REQUIREMENTS:

WORK PLAN/SPECIFICATION _______:

MODIFICATION

VERBALLY NOTIFIED (AS NECESSARY):
IT: ___ No ___ Yes

EMS: ___ No ___ Yes

Additional Subcontractors: ___ No ___ Yes

VERBALLY DISCUSSED AND APPROVED BY: (AS NECESSARY)

PTL: ___ No ___ Yes	DATE: ___________
PM :___ No ___ Yes	DATE: ___________
PRG MAN.: ___ No ___ Yes	DATE: ___________
DOE: ___ No ___ Yes	DATE: ___________

QUALITY AUDITS

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for planning, scheduling, and performing project audits, which are designed to verify compliance to the Quality Assurance Project Plan (QAPP).

2.0 REFERENCES

2.1 *Quality Assurance Project Plan*

2.2 *SQP 4.2 - Records Management*

2.3 *SQP 10.2 - Corrective Action*

3.0 DEFINITIONS

3.1 Audit Team

One of more persons who are responsible for audit performance and reporting. The team may consist of, or is headed by, an individual designated as the Audit Team Leader.

3.2 Audit Team Leader

The individual responsible who organizes and directs the audit, coordinates the preparation and issuance of the Audit Report, and evaluates and performs follow-up of responses.

3.3 Technical Specialist

One or more persons who may be assigned to the audit team due to the specialized or technical aspects of the areas to be audited. Technical Specialists are selected based on their special abilities, specialized technical training, and/or prior experience in the specialized or technical aspects of the area to be audited.

3.4 Audit

A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents, and the effectiveness of implementation. An audit should not be confused with surveillance or inspection activities performed for the sole purpose of process control or product acceptance.

3.5 Finding

A documented statement of fact concerning a noncompliance or deviation from established requirements.

3.6 Observation

A statement of fact regarding the potential for a noncompliance which could lead to a more serious problem if not identified and/or corrected, but which does not constitute a lack of compliance with established requirements.

4.0 PROCEDURE

4.1 Audit Schedule

4.1.1 The Project QA Manager (PQAM)/Project QA Specialist (PQAS) will develop a schedule for the performance of audits. Key elements of the QAPP will be audited on an annual basis. Other QAPP elements will be audited as deemed appropriate by the PQAM. Tasks that are exempt from audit as noted in the Readiness Review (SQP 3.3), Preparatory Phase Inspection (SQP 7.1) or other task planning documents will not be subject to audit.

4.1.2 The audit schedule is based on previous audit results and the results of performance audits and inspections (as applicable).

4.1.3 The audit schedule will be reviewed periodically and revised as necessary to assure that coverage is maintained current.

4.1.4 Unscheduled audits will be used to supplement scheduled audits when conditions warrant.

4.2 Audit Teams

4.2.1 The PQAM/PQAS will designate an Audit Team Leader for each audit to be conducted.

4.2.2 The Audit Team Leader selects and assigns auditors who are independent of any direct responsibility for performing the activities, which they will audit. The Audit Team Leader assures that personnel having direct responsibilities for performing the activities being audited are not involved in the selection of the Audit Team.

4.2.3 The Audit Team Leader orients the team and coordinates the audit to assure communications within the team and with the organization being audited.

4.3 Audit Planning and Preparation

4.3.1 The Audit Team Leader will complete an audit plan, Attachment 6.1, which identifies the following:

- Audit number;
- Audited Organization and Location;
- Audit Scope;
- Audit Purpose;
- Audit Team;
- Reference Documents;
- Audit Schedule;
- Follow-up Items; and,
- Special Concerns.

4.3.2 The Audit Team Leader will assure that the Audit Team is prepared prior to performance of the audit by providing applicable policies, procedures, standards, instructions, codes, regulations, and prior audit reports for information and review by the auditors, and by providing each auditor with the audit plan. In addition, he/she will assure the audit team is familiar with the audited organization and key individuals.

4.3.3 The Audit Team Leader will provide written notification to the organization to be audited of the scheduled audit within a reasonable time before the audit.

4.4 Audit Performance

4.4.1 The Audit Team Leader will conduct a brief pre-audit meeting with management or supervisory personnel of the organization to be audited, to confirm the audit scope, introduce the Audit Team, meet the counterparts, discuss the audit sequence, establish a tentative time for the post-audit meeting, and establish channels of communication.

4.4.2 Audits will be performed in accordance with established checklists or procedures. The auditor(s) will assure that the audit consists of:

- Review of procedures and work instructions for completeness, adequacy, and responsiveness to QAPP requirements.

- Review of work areas for evidence of implementation of procedures and instructions.
- Review of personnel training and qualification records where special skills and qualifications are required.
- Review of selected work, which has been accepted, such as products, design calculations, drawings, and comparison of findings with applicable requirements and the previous basis for acceptance.
- Review of process controls and records to determine conformance with specifications.

4.4.3 Auditor(s) will discuss audit findings with individuals being audited, so that finding(s) as stated, are accurate and understood.

4.4.4 The Audit Team Leader will, at the conclusion of the audit, conduct a post-audit meeting with cognizant management or supervisory personnel of the organization or activity audited, to present the audit findings, observations, or discuss comments.

4.5 Audit Reporting

4.5.1 The Audit Team Leader, upon completion of the audit and with the aid of the audit team members, prepares an audit report using a format, which provides the following information as a minimum:

- Audit number;
- Audited organization;
- Location;
- Scope of audit;
- Audit personnel (indicating lead auditor);
- Audit date(s);
- Persons contacted; and,
- Summary of Audit Results.

Attachment 6.2 will be used as a general guideline for the audit report content and format. For all audits of external organizations, the Audit Team Leader will prepare an audit report cover letter or memorandum for signature and issuance by the PQAM/PQAS. The audit report will be issued to the management of the audited organization.

4.5.2 Audit Reports which contain Quality Finding Reports (QFRs) will require management of the audited organization to submit to the PQAM/PQAS a written response of each QFR identifying:

- The root cause that lead to the condition reported in the finding;

- The steps which have or will be taken to correct the condition reported in the finding;
- The steps which have or will be taken to preclude recurrence (if appropriate); and,
- The dates when indicated action was or will be complete.

4.5.3 Audit Reports, which contain observations, will clearly describe the condition(s), which led to the observation.

4.6 Audit Follow-Up

4.6.1 The PQAM/PQAS will maintain the status of audit findings for active audits and prepare correspondence relating to overdue audit responses. If a request for extension of response is received, an evaluation will be made and a formal response submitted to the requesting organization.

4.6.2 When responses are overdue, the PQAM/PQAS notifies the responsible organization by telephone that responses are overdue and prepares a memorandum or letter indicating a new response due date. Responses not received within the period of time established for the extension will result in the issuance of a Corrective Action request (Reference 2.3).

4.6.3 The PQAM/PQAS, upon receipt of responses to audit findings, will coordinate with the Audit Team Leader for the evaluation of responses.

4.6.4 The responsible evaluator will document the results of the evaluation on the QFR.

4.6.5 Unacceptable responses will be noted on the QFR together with the specific reason for rejection. The PQAM/PQAS will prepare transmittal correspondence reissuing the QFR to the responsible organization, delineate a new response due date, and include a copy of the original QFR with evaluation comments. Review and distribution of the reissued QFR will be the same as the original report.

4.6.6 The PQAM/PQAS will assure that verification of corrective action implementation is accomplished and document the results of verification on the QFR record copy.

NOTE: Unacceptable verification will be handled in accordance with Paragraph 4.6.5.

4.6.7 Upon completion (close-out) of all QFRs, the PQAM/PQAS will notify the audited organization by memorandum or letter that all actions are complete, have been approved and that the audit is closed.

5.0 RECORDS

5.1.1 The following documents are generated as a result of implementation of this procedure:

- Audit plans

- Audit reports
- Quality finding reports, including response, evaluation, and verification
- Audit closure letter
- Correspondence related to the audit

5.1.2 Documents identified in paragraph 5.1 will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Audit Plan

6.2 Audit Report Format and Content

6.3 Quality Audit Finding Report

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

AUDIT PLAN

AUDIT PLAN

Company:

Audit Number ______________ Audit Organization ______________

Contract Number: ______________ Location: ______________

Audit Scope: ______________

AUDIT PERSONNEL

Lead Auditor: ______________

Auditor: ______________

Auditor: ______________

Auditor: ______________

AUDIT SCHEDULE

Audit Dates: ______________

Pre-Audit Conference: ______________ Time: ______________

Post-Audit Conference: ______________ Time: ______________

Reference Documents: ______________

Follow-up Items: ______________

Special Concerns/Items: ______________

AUDIT TEAM ASSIGNMENTS

Lead Auditor: ______________ ______________

Auditor: ______________ ______________

Auditor: ______________ ______________

Auditor: ______________ ______________

REVIEW AND CONCURRENCE PRIOR TO AUDIT (SIGN AND DATE)

Lead Auditor: ______________ Date: ______________

Auditor: ______________ Date: ______________

Auditor: ______________ Date: ______________

Auditor: ______________ Date: ______________

REVIEW AND APPROVAL OF ATTACHED AUDIT CHECKLIST (IF APPLICABLE) (SIGN AND DATE)

Lead Auditor: ______________ Date: ______________

REVIEW AND APPROVAL PRIOR TO AUDIT (SIGN AND DATE)

Lead Auditor: ______________ Date: ______________

PQA Manager: Date:

ATTACHMENT 6.2

AUDIT REPORT FORMAT AND CONTENT

AUDIT REPORT FORMAT AND CONTENT

As applicable and appropriate, audit reports will include the following information in the following general order:

1. INTRODUCTION

1.1. Purpose

The Purpose section shall state the scope and reason for the audit, and any extenuating circumstances which may have caused the audit to be conducted. If the audit is a regularly-scheduled audit, this shall be clearly stated.

1.2. Audit Team

List the auditors and identify the audit team leader.

1.3. Personnel Contacted

List the personnel contacted during the audit. Personnel attending the pre-audit and post-audit meetings should be identified by a plus sign (+) and an asterisk (*), respectively.

2. SUMMARY

2.1. Describe the method of audit for each area audited (i.e., review of procedure; sampling of hardware, records, etc., interview).

2.2. Document areas audited and found satisfactory.

2.3. Provide a summary of the effectiveness of those elements of the QA program audited.

2.4. Provide any additional comments related to the audit.

2.5. List the audit discrepancies by QFR number. This summary should be a direct quote from the QFR.

2.6. List the items of concern as observations.

2.7. List action taken on previous QFRs (i.e., follow-up verification, close-out, reissue).

3. QUALITY FINDING REPORTS

QFRs shall be prepared in the following format. They shall be self-explanatory and contain the required pertinent information.

3.1. Finding:

A concise statement of the situation, including the requirement violated, complete to the extent that the finding will stand on its own.

Where additional discussion is determined to be necessary, the discussion shall relate any pertinent facts involved including identification of the repetitive nature of the finding, if applicable. When appropriate, specific assignment of responsibility may be included in the discussion.

ATTACHMENT 6.3

QUALITY AUDIT FINDING REPORT

QUALITY AUDIT FINDING REPORT

Company:

Audit Number:	QAFR Number:	Date:
Organization/Project/Department:		Person Contacted:
Finding (Include Specific Requirement Violated):		
Auditor:		Response Due Date:
Root Cause Which Led To The Condition Reported:		
Corrective Action Taken/Proposed To Correct Deficiency:		
Corrective Action Taken To Preclude Recurrence:		

Corrective Action Taken By (Signature and Title:)		Date When Corrective Action Will Be Completed:	
Corrective Action Evaluation:		Verification Of Implementation:	
Evaluator	Date	Verified By	Date

MANAGEMENT ASSESSMENT

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for performing assessments of the Program by management, above or outside of the quality assurance organization, responsible for the implementation of the Quality Assurance Project Plan. Management assessments are conducted to determine the status and adequacy of the Management System, determine the effectiveness of implementing procedures, evaluate program performance versus program goals and verify that the Management System adequately protects the public, the workers and the environment.

2.0 REFERENCES

2.1 *Quality Assurance Project Plan*

2.2 *SQP 4.2 - Records Management*

3.0 DEFINITIONS

*3.1 Managemen*t

3.1.1 The Program Manager for activities internal to the program (i.e., at the Program Management office).

3.2 Assessment

3.2.1 An all-inclusive term used to denote any of the following: audit, performance evaluation, management systems review, peer review, or surveillance performed by, or for, management.

4.0 PROCEDURE

4.1 Regular Assessment

4.1.1 Regular assessments are performed by the Program Manager utilizing a combination of formal and informal evaluation activities as described below.

Formal assessments are conducted by use of the following methods as applicable:

- Review of and response to contractor conducted Quality Assurance program and delivery order audits.
- Review and approval of reports or portions of reports that are contract deliverables.

Informal evaluations are conducted by use of the following methods as applicable:

- Review of responses to Nonconformance Reports (NCRs).
- Review of Corrective Actions (CAs).
- Daily contact with program and delivery order personnel.

4.1.2 Regular assessments by the Program and Project Manager(s) are documented as follows for the formal and informal evaluation activities:

Formal evaluation documentation is provided by the following methods as appropriate

- Receives copies of all project internal audits. Signs the transmittal letters transmitting external audit responses.
- Contractor generated reports or portions of reports are signed by the Program or Project Manager on the transmittal document for final reports, which are contract deliverables.

Informal evaluations do not require documentation by the program or project manager since they are on formal distribution for project correspondence, Nonconformance Reports, and other reports where quality and program or delivery order requirements are discussed.

4.2 Annual Assessment

4.2.1 Annual assessments are performed through a review of program quality- and safety-related activities and control mechanisms. This assessment will include reviews of NCRs/CAs and Internal Audit Reports, accident, injury, illness and occurrence report, all of which will include a review of specified corrective actions, results of verifications conducted to assure implementation of corrective actions and the results of follow-up verifications. Annual assessments are conducted by someone not directly involved in the program, either the Executive Sponsor or his designee.

4.2.2 Annual assessments will review the program performance against the following minimum program goals:

- No Recordable Occupational Injury or Illness resulting in one lost work day, requiring hospitalization exceeding 48 hour per person-incident, or resulting in long term physical disability,
- No work related fatality attributable to Health and Safety related incident caused by the Contractor's or Subcontractor's negligence,

- No Occupational Safety and Health violations,
- No environmental regulatory violations documented by a cognizant statutory regulatory agency and accepted by as appropriate by DOE,
- Any additional environmental protection goals, established in specific Work Plans,
- ALARA goals established per LEHR ALARA Program, and
- Radioactive Waste Management goals, if any, identified in the Radioactive Waste Management Program.

4.2.3 The results of the assessment will be documented in a formal report. The report will be distributed to the Program Manager, Project Manager and Project Task Leader, as appropriate, for their information and input in correcting deficiencies and improving project performance.

4.2.4 After receiving the Annual Assessment Report, the program office staff and project manager will assure that corrective actions for the unacceptable conditions noted in the report are accomplished and submit a memorandum to the Executive Sponsor and Program Manager informing him of the completion of required corrective actions or the anticipated date when corrective actions will be complete.

4.2.5 The Program Manager will provide a follow-up verification of the implementation of the corrective actions and upon completion issue a memorandum indicating the closed status of those actions. As part of the memorandum, the Program Manager will provide a statement validating that the corrective action implemented actually addressed and corrected the unacceptable conditions.

5.0 RECORDS

5.1.1 Documents generated as a result of implementation of this SQP will be maintained for each Annual Assessment and will include the following:

- The formal report;
- The memorandum of corrective action and verification (as applicable); and,
- The memorandum which closes the Annual Assessment Report.

5.1.2 Documents identified in 5.1 will be considered records, after closure of each Annual Assessment and will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

None.

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

QUALITY SURVEILLANCES

STANDARD QUALITY PROCEDURE

1.0 PURPOSE

This Standard Quality Procedure (SQP) establishes the methods and responsibilities for the conduct of surveillances in process activities to assure the effective implementation of the QAPP requirements.

2.0 REFERENCES

2.1 *Quality Assurance Program Plan*

2.2 *SQP 4.2 - Records Management*

2.3 *SQP 10.2 - Corrective Action*

3.0 DEFINITIONS

3.1 Surveillance

The act of monitoring or observing to verify whether an item or activity conforms to specified requirements.

4.0 PROCEDURE

4.1 Discussion

4.1.1 Surveillances are conducted to verify that activities which affect quality are being conducted in accordance with the requirements of the Quality Assurance Project Plan and implementing procedures. Surveillances may be performed on in-process work activities as well as completed work. They are performed as unscheduled, announced, and unannounced verifications to assess activities and performance of personnel who are implementing the QAPP.

4.2 Responsibilities

4.2.1 The Program Manager is responsible for overall program operations. He is responsible for the proper implementation of the QAPP requirements.

4.2.2 The Program QA Manager (PQAM) and Project QA Specialist (PQAS) are responsible for conducting surveillances of quality affecting activities. Additionally, he/she assures that discrepancies identified during surveillances are documented, reported, and follow-up verification of corrective measures are conducted.

4.3 Performance of Surveillance

4.3.1 The PQAM or PQAS conducts surveillances at periodic intervals. He/she may select other personnel to participate in surveillances as appropriate. Personnel performing surveillances will be selected based on background, education, experience, capability, and the judgment of the PQAM or PQAS. It is not necessary to document the selection process. The performance of surveillances supplements but does not replace the requirements for scheduled audits of activities or inspections.

4.3.2 Prior to performing surveillances, the PQAM or PQAS will provide surveillance personnel with any necessary information (i.e., procedures, specifications, drawings, etc.).

4.3.3 The PQAM or PQAS will, through discussion with surveillance personnel, assure that surveillance personnel are familiar with the activity and the requirements applicable to the activity being surveilled and proceed with the surveillance.

4.3.4 Surveillance personnel will verify the following as a minimum:

- The activity is proceeding in accordance with current approved procedures;
- Personnel conducting the activity, as applicable, have been appropriately selected by project management (i.e., interdisciplinary reviews, independent technical reviews, audits, etc.); and,
- Personnel performing the activity have received the required indoctrination and specific training required to perform the activity.

4.4 Surveillance Reporting

4.4.1 Upon completion of the surveillance activity, any comments or discrepancies noted will be discussed with the personnel performing the activity. Significant comments and discrepancies will be documented on the Surveillance Report, Attachment 6.1.

4.4.2 Discrepancies found during the surveillance which are determined by the PQAM or PQAS not to be significantly adverse to quality will be reported by issuance of the surveillance report to management responsible for that activity.

4.4.3 Responsible management will, upon receipt of the surveillance report, establish proposed corrective action for the discrepancies identified. Proposed corrective action will be documented on the surveillance report and must include the date when corrective action will be complete.

4.4.4 The surveillance report with proposed corrective action is forwarded to the program or delivery order manager, as applicable, for approval of the proposed corrective action.

4.4.5 The program or delivery order manager, as appropriate, forwards approved surveillance reports to the PQAM or PQAS. Responses to surveillance reports must be submitted to the PQAM or PQAS within thirty (30) days after receipt of the surveillance report.

4.4.6 Discrepancies found during the surveillance which are determined by the PQAM or PQAS to be significantly adverse to quality will be documented on the surveillance report and also on a Corrective Action Request (CAR), the CAR number will be referenced on the surveillance report. The surveillance report is then closed as a result of the CAR being issued. Corrective Action Requests which are generated as a result of this procedure will be handled and controlled in accordance with SQP 10.3.

4.4.7 Surveillance personnel will, at the conclusion of the surveillance, conduct a brief post-surveillance meeting with cognizant management or supervisory personnel of the activity surveilled, to discuss discrepancies noted and any comments.

4.5 Surveillance Follow-up

4.5.1 The PQAM or PQAS maintains the status of discrepancies for active surveillance reports and follows-up on overdue responses.

4.5.2 The PQAM or PQAS, upon receipt of dispositioned surveillance reports, performs an evaluation of the proposed corrective action. If the proposed corrective action is acceptable, the PQAM or PQAS signs the surveillance report in the "Approved" section.

4.5.3 Unacceptable responses will be noted on the surveillance report together with the specific reason for rejection. The PQAM or PQAS will reissue the surveillance report to the responsible organization, delineating a new response due date, and include a copy of the original surveillance report with evaluation comments. Review and distribution of the reissued surveillance report will be the same as the original report.

4.5.4 The PQAM or PQAS will assure that verification of corrective action implementation is accomplished and document the results of the verification on the surveillance report.

NOTE: Unacceptable verification will be handled in accordance with Paragraph 4.5.3

4.5.5 Upon completion (close-out) of the surveillance report, the PQAM or PQAS will notify responsible management by memorandum that all actions are complete and have been approved.

5.0 RECORDS

5.1.1 The following documents may be generated as a result of this procedure:

- Surveillance Reports
- Surveillance Report Response Memorandums
- Surveillance Report Closure Memorandum

- Correspondence Related to the Surveillance

5.1.2 Documents identified in 5.1 will be considered records after closure of each surveillance and will be controlled and maintained in the project record files in accordance with SQP 4.2.

6.0 ATTACHMENTS

6.1 Quality Assurance Project Surveillance Report

A form referenced or attached to this SQP may be replaced with a substitute form, with the approval of the PQAM, if the substitute form contains equivalent information as the referenced form.

ATTACHMENT 6.1

QUALITY ASSURANCE PROJECT SURVEILLANCE REPORT

QUALITY ASSURANCE PROJECT SURVEILLANCE REPORT

Company:

Originator:	Surveillance No.:	Date:	Location:

Activities Under Surveillance:	☸ In Process	☸ Completed

Surveillance Personnel:	Individuals Contacted:
Surveillance REF (Plan, Procedure):	

Surveillance Results:

Deficiencies (Include Specific Requirement(s) Violated As Applicable:

Proposed Corrective Action, As Applicable:	
	Corrective Action Completion Date:

Project Manager:	Date:	PQA Manager:	Date:

CORRECTIVE ACTION COMPLETED		
Title:	Signature:	Date:

VERIFICATION
Verification Results: ☸ Accept ☸ Reject ☸ Elevated to NCR No.: ______________________

Verified By:	Date:	PQA Manager:	Date:

Verification Comments: