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Long-Term Surveillance and Maintenance Plan for the Former Laboratory for Energy-Related Health Research Federal Facility University of California, Davis

September 2013

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Document History

Version No./ Revision No.	Date	Description of Change
2.0	09/25/2013	Updated the groundwater monitoring program. Performed a complete review and revision as required by contractor controlled document procedure.
1.0	09/21/2012	Updated the groundwater monitoring program.
0.1	09/13/2011	Updated to note that the new monitoring wells have been installed.
0.0	01/12/2011	Initial issue under the LMS contract.

Approved:

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2013.09.24 07:59:21
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Abbreviations

ARAR	applicable or relevant and appropriate requirement
C-14	carbon-14
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Co-60	cobalt-60
COC	constituent of concern
CRWQCB	California Regional Water Quality Control Board
Cs-137	cesium-137
DOE	U.S. Department of Energy
DQO	data quality objective
DSS	Domestic Septic System
DTSC	California Department of Toxic Substances Control
EDPs	Eastern Dog Pens
EERF	Eastern Environmental Radiation Facility
EPA	U.S. Environmental Protection Agency
ft	feet
HSU	hydrostratigraphic unit
ID	identification
LEHR	Laboratory for Energy-Related Health Research
LTS&MP	Long-Term Surveillance and Maintenance Plan
µg/L	micrograms per liter
MCL	maximum contaminant level
mg/L	milligrams per liter
MOC	monitoring-only constituent
pCi/L	picocuries per liter
QAPP	Quality Assurance Project Plan
Ra/Sr	radium/strontium
Ra-226	radium-226
RD/RAWP	Remedial Design/Remedial Action Work Plan
ROD	Record of Decision
SOP	Standard Operating Procedure
SQP	Standard Quality Procedure
Sr-90	strontium-90

Stoller	S.M. Stoller Corporation
SWT	Southwest Trenches
UC Davis	University of California, Davis
WDPs	Western Dog Pens

1.0 Introduction

The objective of this Long-Term Surveillance and Maintenance Plan (LTS&MP) is to implement the requirements 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. They include long-term groundwater monitoring, contingency remediation, and land-use restrictions, including a Soil Management Plan (Appendix A) and prohibition of residential use.

Provided in this plan are procedures to implement the selected remedies listed in Table 1, which include:

- Land-use restrictions.
- Long-term groundwater monitoring.
- Contingency remediation.

Table 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) at the location shown in Figure 1. 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 (CRWQCB), Central Valley Region, 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 2, 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 area
- 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 areas, Dry Wells A–E, and the EDPs area) (Figure 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 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). The former LEHR facility (Figure 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.

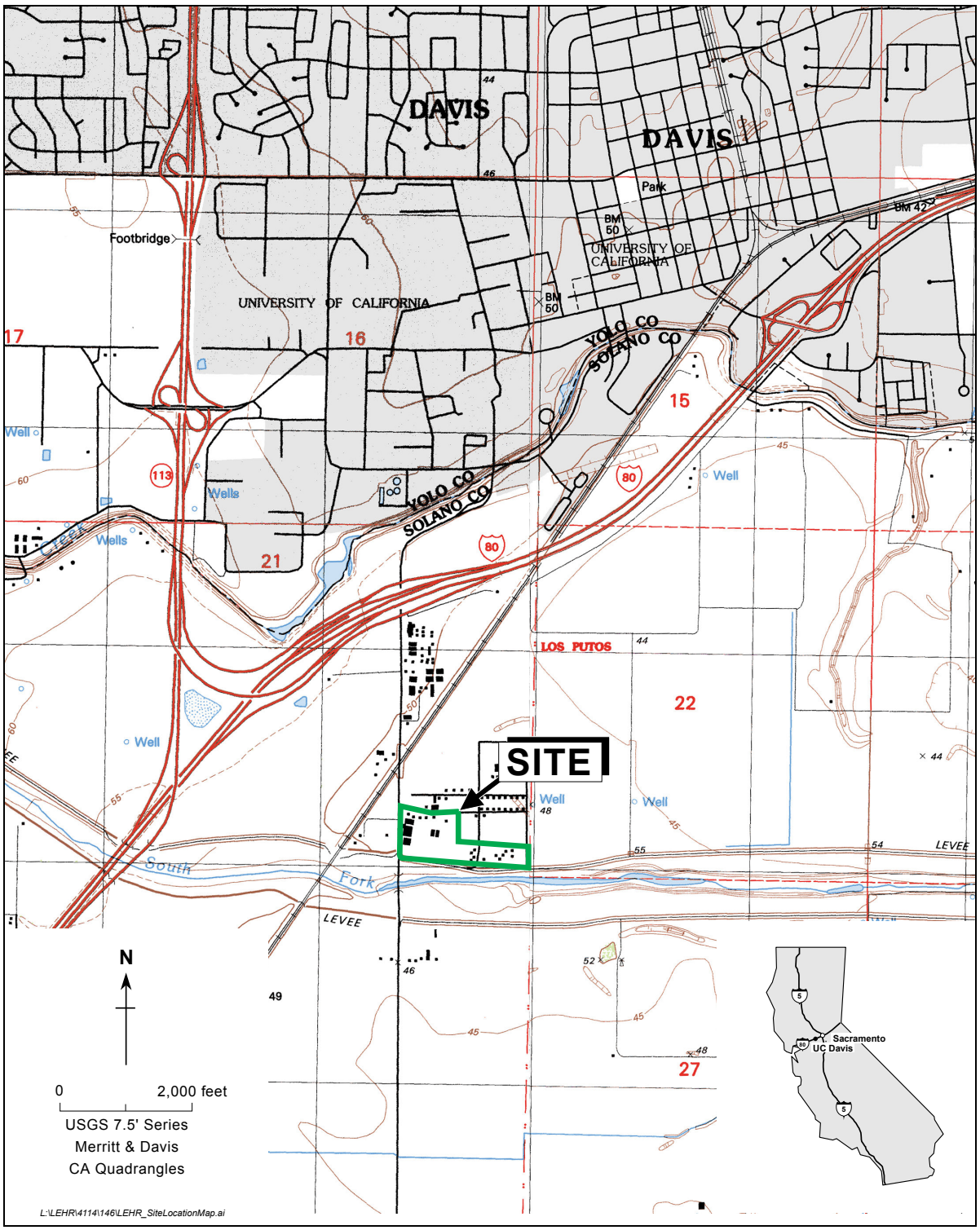

Figure 1. Location of the LEHR Site, UC Davis, Solano County, California

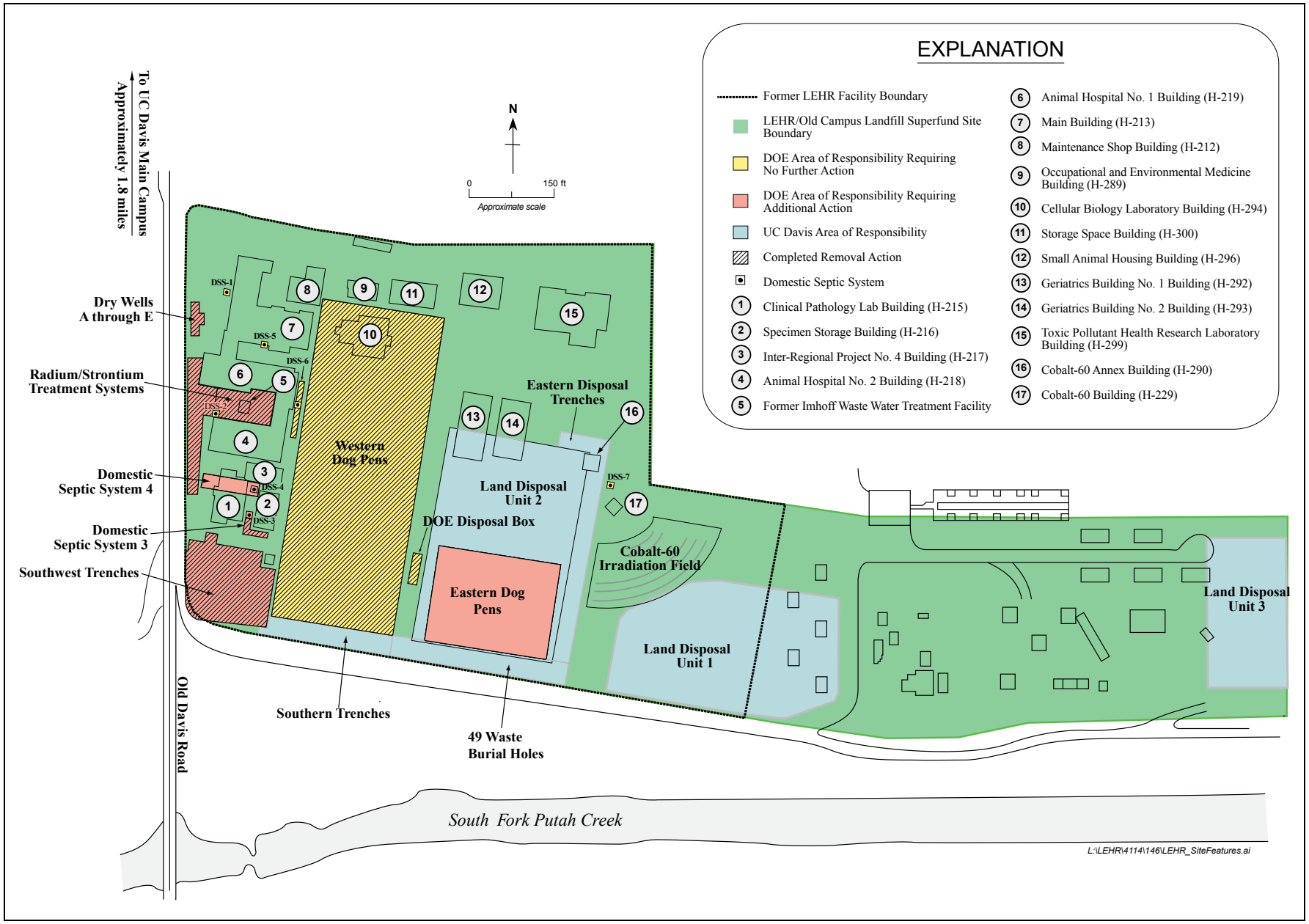

Figure 2. LEHR Site Features

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). Research at LEHR through 1988 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.

A campus landfill with two waste burial units used from the 1940s until the mid-1960s is at the site (Figure 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, DOE removed gravel and curbing from 64 pens in the WDPs area.
- In 1995, DOE demolished the Imhoff Wastewater Treatment Facility (Figure 2) as a voluntary removal action.
- In 1995 and 1996, DOE removed concrete pedestals and wooden barrels from the EDPs area and the WDPs area and disposed of them as low-level radioactive waste at the Hanford site in Washington (Weiss 1997).
- In 1996, DOE removed the pedestals from the WDPs area and the EDPs area 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 No. 1 building, the Animal Hospital No. 2 building, the Specimen Storage building, and the Co-60 building) (Figure 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, DOE conducted a time-critical removal action at the DOE Disposal Box area.

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

At the DSS 7 area, human health risks were below 1 in 1 million, and ecological risks were insignificant, so no removal action was performed, and no further action is required.

A risk assessment at the DOE Disposal Box area 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 area. A risk assessment performed after the four non-time-critical removal actions in the SWT area; the Ra/Sr Treatment Systems area; the DSS 1, 2, 3, 5, and 6 areas; the Dry Wells A–E area; and the WDPs area 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 areas (Weiss 2005), but ecological risks were insignificant (BBL 2006).

Table 2 summarizes risks for the three 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 area, the Ra/Sr Treatment Systems area, Dry Wells, and the DSS 3 and 4 areas, as discussed below. No further action is required at the WDPs area and the DSS 1, 2, 5, 6, and 7 areas.

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, or (2) their potential to impact groundwater above background levels. As discussed above and shown in Table 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 3 lists the COCs at each DOE area identified as presenting potential human health cancer risks that exceed 1 in 1 million. As described in the *Final DOE Areas Feasibility Study for the Laboratory for Energy-Related Health Research, University of California, Davis* (Weiss 2008), the remediation goals for these COCs represent a cancer risk of 1 in 1 million.

Table 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	**Onsite 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**
	Onsite 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	**Onsite 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	**Onsite 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, Volume I: Human Health Risk Assessment*, Tables 7 and 8 (UC Davis 2004a). Constituents and risks are presented here if (1) the constituent is present above site background and if (2) 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 because they will be addressed by the UC Davis Feasibility Study.
Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
[a] The 95 percent upper confidence limit on the mean or maximum sample concentration.
[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 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	**Onsite 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
	Onsite Construction Worker		
	Benzo[*a*]pyrene	2.4	2
Southwest Trenches	**Onsite Resident**		
	Strontium-90+daughter	0.94	0.3
Eastern Dog Pens	**Onsite Resident**		
	Dieldrin	0.019	0.006
	Strontium-90+daughter	0.33[c]	0.3

Notes:
Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
[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 a risk of 1 in 1 million, determined using one significant figure total cancer risk. All concentrations are based on dry weight of soil sample.
[c] Exposure point concentration after Eastern Dog Pens maintenance action.

Table 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 that exceeds 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 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 area; the Ra/Sr Treatment Systems area; the EDPs area; and the DSS 1, 3, 4, 5, and 6 areas. Groundwater at the site shall be monitored for these constituents.

Table 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[h]	4.0	35
Dry Wells A–E	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[l,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[l,J]

Notes:
Chemical concentrations are expressed in milligrams per kilogram, and radionuclide concentrations are expressed in picocuries per gram.
[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 maximum contaminant level 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 the soil background concentration. Calculated remediation goals are presented in the *Site-Wide Risk Assessment, Volume I: Human Health Risk Assessment (Part B Risk Characterization 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 that exceed the remediation goals. However, selenium was retained as a COC due to its presence (one result) in a downgradient hydrostratigraphic unit 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).

Abbreviations:
MCL = maximum contaminant level

Table 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

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 3 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, 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 the DSS 4 area.
- 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 3 and 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 3 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. Between January 31 and February 18, 2011, a professional land surveyor licensed by the California Board for Professional Engineers and Land Surveyors installed 24 brass monuments and surveyed the

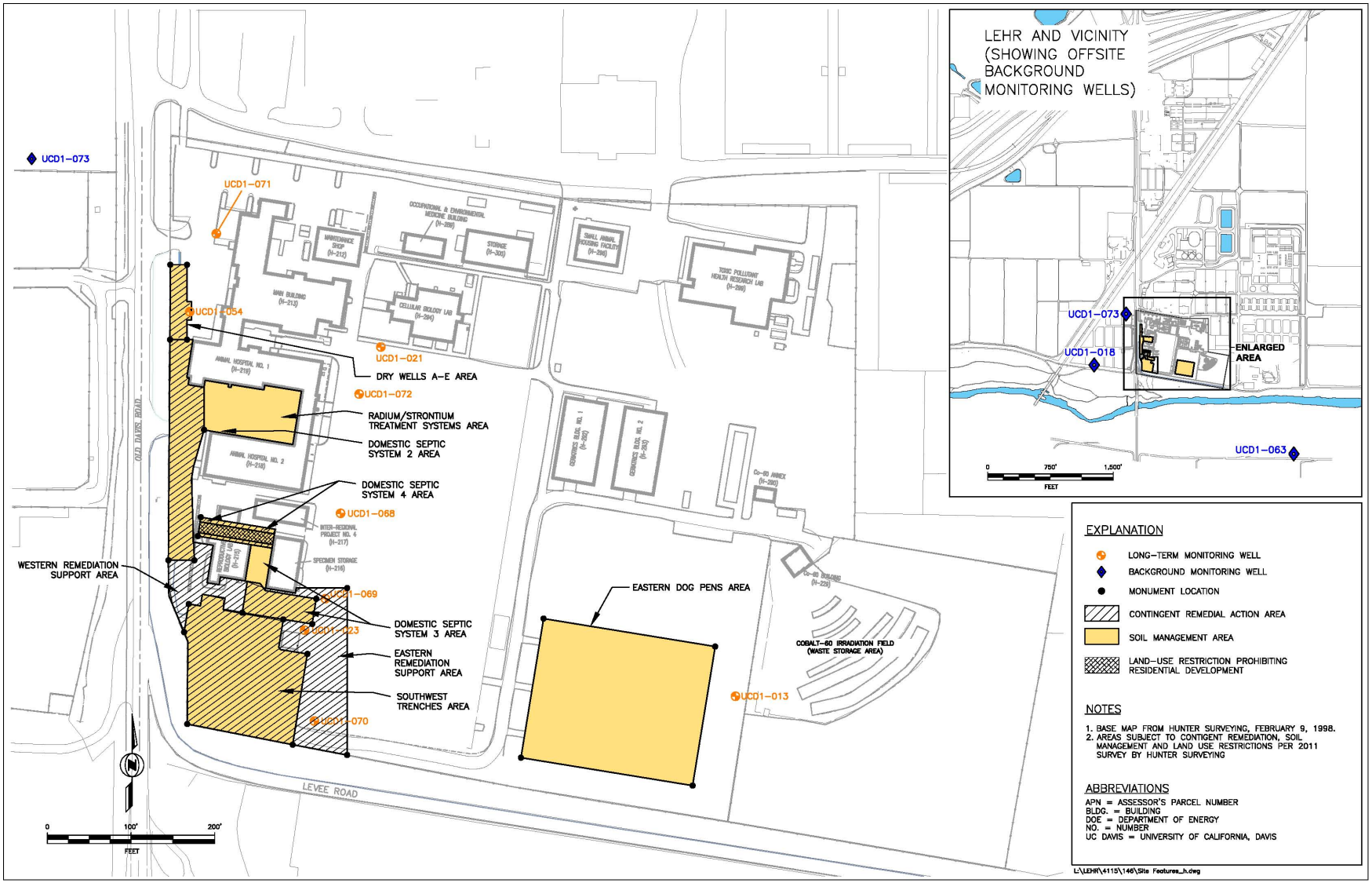

Figure 3. DOE Areas of the LEHR Federal Facility Subject to Land-Use Controls

boundaries of DOE land-use control areas and potential future remediation support areas. The surveyor developed a certified map and legal descriptions for the surveyed areas, which shall be recorded as discussed in Section 2.2 below.

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

2.1.1 Residential Use Restriction at the 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, will 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 from within the building.

A covenant is being prepared and will 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. A covenant is a legal document attached to the deed for real property that memorializes land-use restrictions for the subject property.

2.1.2 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) are not 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 is prohibited in the draft land-use covenant. DOE attached a plaque and tag containing a discrete identifier (CERCLA Groundwater Monitoring Well No. UCDX-XXX) to all wells in the monitoring system (UCD1-013, -018, -021, -023, -054, -063, and UCD1-068 through UCD1-073). The plaques and tags state that destroying or tampering with the wells is prohibited.

2.1.3 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, except areas where No Action or No Further Action was identified. All soil-disturbing activities—including excavation, grading, trenching, and utility installation or repair—are subject to the requirements of the Soil Management Plan (see 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 information about 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 or whether environmental fate and transport should be estimated.
- Identification of other required plans, permits, and documentation.
- Soil management procedures.
- Sampling and analysis procedures.
- Waste characterization and disposal.
- Reporting and recordkeeping.

A covenant prohibiting the commencement of soil-disturbing activities that do not comply with the Soil Management Plan is being prepared and will 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

Once a covenant is signed and recorded, it runs with the land pursuant to *California Health and Safety Code* Section 25355.5 and *California Civil Code* Section 147.1. It 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 DTSC.[1]
- Is for the benefit of EPA as a third-party beneficiary.[2]
- Is imposed on the entire property unless expressly stated as applicable only to a specific portion thereof.

The Draft Final Land Use Covenant was issued by DTSC on June 13, 2013. This covenant addresses the requirements of Sections 2.1.1, 2.1.2, and 2.1.3 and will be signed by the University of California and DTSC, with EPA listed as a third-party beneficiary.[3]

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

After the covenant has been signed, the University of California will record it 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. The final Land Use Covenant is expected to be recorded before the close of 2013.

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 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 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, in accordance with Section 4.1.4 of the Soil Management Plan [Appendix A]).
- 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 changes that are inconsistent with the land-use controls and assumptions described in the ROD (DOE 2009b) and the Remedial Design/Remedial Action Work Plan (RD/RAWP) (DOE 2010).
- 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.
- 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 6 months before any transfer or sale of the property.
- 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 might 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.

The regulatory agencies must approve any modification of land-use controls. 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 all of the following:

- 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).
- 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 or the work conducted, and mitigation or control measures employed to protect human health and the environment. For excavation or other soil-disturbing activities, additional information described in Section 5.0 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 Five-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 the following:

- 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.
- 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 Five-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 second report will be due to DTSC and EPA on January 10, 2014. The reports shall include the following:

- Annual inspection results.
- Results of inspections conducted to comply with the requirements of the Soil Management Plan.
- A certification attesting to compliance with the terms and conditions of the land-use covenants.
- 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 Table 3 and Table 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 Five-Year Reviews to ensure that the selected remedy remains protective. The Soil Management Plan shall be maintained and updated during Five-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 Five-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).

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3.0 Long-Term Groundwater Monitoring Program

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 was implemented in 2011 and is ongoing to ensure that if contaminants begin to impact groundwater, remedial action will be taken to prevent the degradation of water quality. Monitoring will continue until contaminants in soil no longer pose a threat to groundwater, as described in Section 3.5.

The RD/RAWP describes the process approved by the LEHR Project Team (DOE, EPA, DTSC, CRWQCB, and the California Department of Public Health) for determining which COCs and wells will be included in the DOE areas monitoring program (DOE 2010). The monitoring program decision process for COCs is presented in Figure 5. In accordance with this process, groundwater monitoring data will be evaluated annually, and the program will be adjusted accordingly. As agreed in the January 24, 2012, LEHR Project meeting, groundwater background and baseline conditions were determined using data collected during 2011 and 2012, the first 2 years of monitoring (LEHR Project Team Meeting Minutes 2012), and presented in Section 5.0 of the 2012 Comprehensive Annual Water Monitoring Report (Weiss 2013c). The monitoring program described below is the outcome of the RD/RAWP decision process as well as modifications that the LEHR Project Team agreed on during its February 12 and August 21, 2013, meetings (LEHR Project Team Meeting Minutes 2013a and 2013b). Monitoring program changes between 2012 and 2013 are shown in Table 6. The DOE areas sampling plan for 2013 is presented in Table 7 and summarized below. This sampling plan will be updated annually based on the RD/RAWP decision process. If sampling does not indicate increasing trends above background, the sampling plan shown in Table 7 will continue until the Five-Year Review.

This section presents the current purpose of each well in the monitoring program, compliance monitoring requirements (e.g., frequency, analytical methods), and procedures for evaluating remedial options if groundwater is impacted.

3.1 Groundwater Monitoring Locations

Between 2011 and 2013, groundwater monitoring was performed at 12 wells (UCD1-013, UCD1-018, UCD1-021, UCD1-023, UCD1-054, UCD1-063, and UCD1-068 through UCD1-073). To better define background gross beta activity at the site, the regulatory agencies requested additional sampling at wells UCD1-055, UCD1-058, and UCD1-061, beginning in 2014. Figure 4 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 may vary seasonally and become 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 area COCs that reach HSU-1 groundwater might migrate downgradient more slowly than this due to retardation. Monitoring well locations are 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 distant to

Table 6. Changes to the DOE Areas Water Monitoring Program, 2012 to 2013

Well	Area Monitored	Program Year	Radiological Analysis								Chemical Analysis																		
			Americium-241	Beta, Gross	Carbon-14	Cesium-137	Potassium-40	Radium-226	Strontium-90	Uranium-238	Aluminum	Benzene	Chlordane	Chloroform	Chromium, Hexavalent	Chromium, Total	Copper	1,1-Dichloroethane	Dieldrin	Formaldehyde	Iron	Manganese	Mercury	Molybdenum	Nickel	Nitrate (as Nitrogen)	Selenium	Silver	Zinc
UCD1-013	Eastern Dog Pens	2012											A						A										
		2013											A						A										
UCD1-018	Background	2012	A	S	S	S	A	S	S	S	S				Q	S	S			S	S	S	Q	S	A	S	Q	S	A
		2013		A																									
UCD1-021	Ra/Sr System and DSS 5	2012	A		S			S			A															S			
		2013	A		A			A			A															A			
UCD1-023	Southwest Trenches	2012			S																		A			S			A
		2013			A																		A			A			A
UCD1-054	Dry Wells	2012				S			S						S	S							S	S				S	
		2013				A			A						A	A							A	A				A	
UCD1-055	Background	2012																											
		2013		A																									
UCD1-058	Background	2012																											
		2013		A																									
UCD1-061	Background	2012																											
		2013		A																									
UCD1-063	Background	2012	A	S	S	S	A	S	S	S	S				Q	S	S			S	S	S	Q	S	A	S	Q	S	A
		2013		A																									
UCD1-068	Ra/Sr System and DSS 4	2012	A	S	S		A	S		S	A			S	S	A				S					A	S	Q		
		2013	A	A	A			A		A	A			A	A	A				A					A	A	A		
UCD1-069	DSS 3	2012		S	S		A			S	S			S			S	S		S	S	S		S		S		A	
		2013		A	A					A	A			A				A		A	A	A		A		A		A	
UCD1-070	Southwest Trenches	2012		S	S		A			S													A			S			A
		2013		A	A					A													A			A			A
UCD1-071	Dry Wells and DSS 1	2012		S		S	A		S	S	A	S			Q	S						S	Q	S				S	
		2013		A		A			A	A	A	A			A	A						A	A	A				A	
UCD1-072	Ra/Sr System and DSS 6	2012	A	S	S		A	S		S	S			S	S	S				S						S			
		2013	A	A	A			A		A	A			A	A	A				A						A			
UCD1-073	Background	2012	A	S	S	S	A	S	S	S	S				Q	S	S			S	S	S	Q	S	A	S	Q	S	A
		2013		A																									

Notes:

No change in sampling frequency
Decrease in sampling frequency
New constituent
Deleted constituent

Abbreviations:

A = annual DSS = domestic septic system Q = quarterly Ra/Sr = radium/strontium S = semiannual

Table 7. 2013 DOE Sampling Plan

Well Name	1,1-Dichloroethane	Aluminum	Americium-241	Benzene	Beta, Gross	Carbon-14	Cesium-137	Chlordane	Chloroform	Chromium, Hexavalent	Chromium, Total	Dieldrin	Formaldehyde	Iron	Manganese	Mercury	Molybdenum	Nickel	Nitrate (as Nitrogen)	Radium-226	Selenium	Silver	Strontium-90	Uranium-238	Zinc
UCD1-013								A				A													
UCD1-018[a]					A																				
UCD1-021		A	A			A													A	A					
UCD1-023						A										A			A						A
UCD1-054							A			A	A					A	A					A	A		
UCD1-055[a]					A																				
UCD1-058[a]					A																				
UCD1-061[a]					A																				
UCD1-063[a]					A																				
UCD1-068		A	A		A	A			A	A	A		A					A	A	A	A			A	
UCD1-069	A	A			A	A			A				A	A	A		A		A			A		A	
UCD1-070					A	A										A			A					A	A
UCD1-071		A		A	A		A			A	A				A	A	A					A	A	A	
UCD1-072		A	A		A	A			A	A	A		A						A	A				A	
UCD1-073[a]					A																				

Notes:

- Monitoring-only constituent
- New well constituent
- Constituent of concern

[a] Well monitors background groundwater concentrations for selected constituents.

Abbreviations:
A = annual Q = quarterly S = semiannual

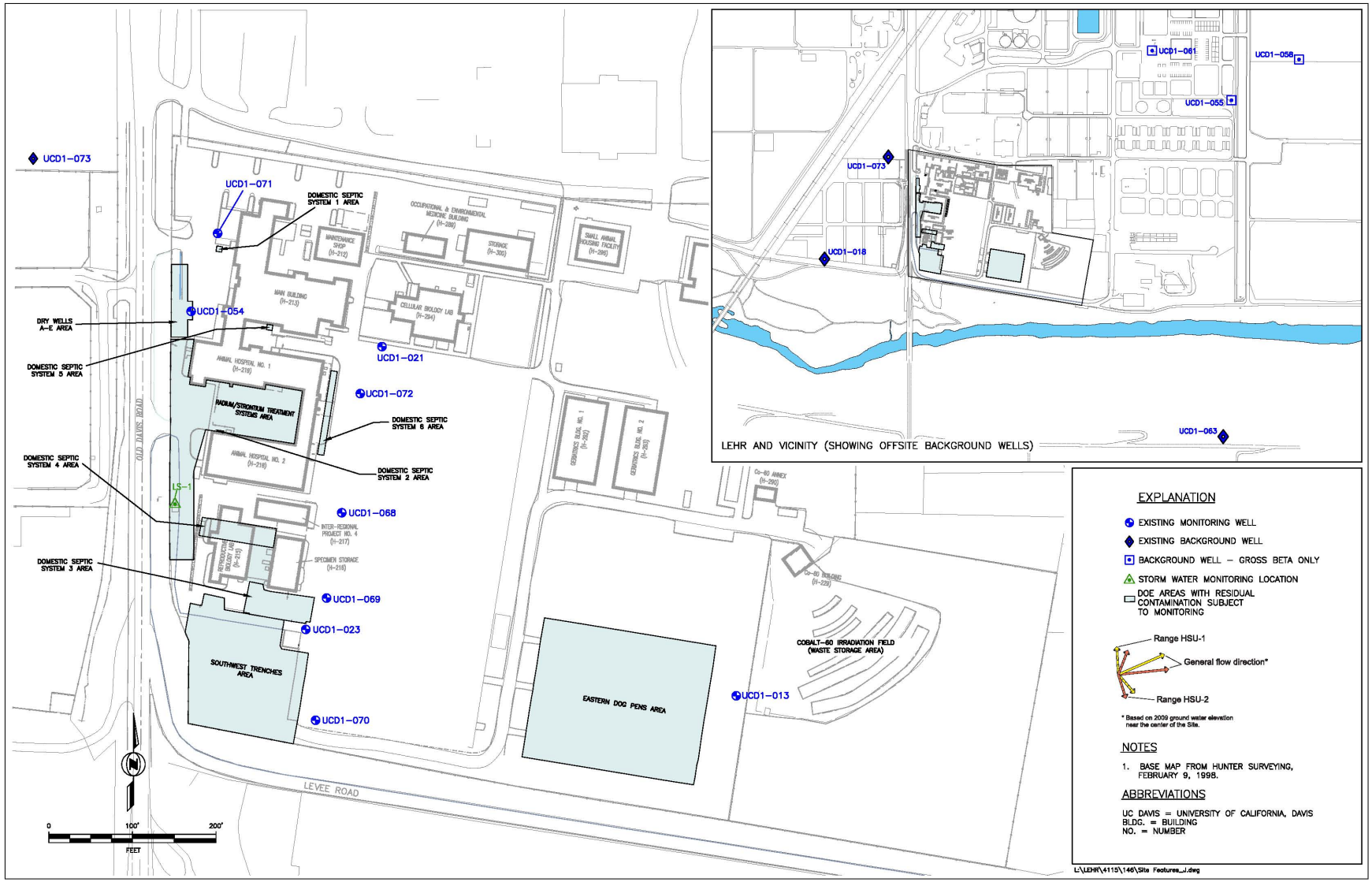
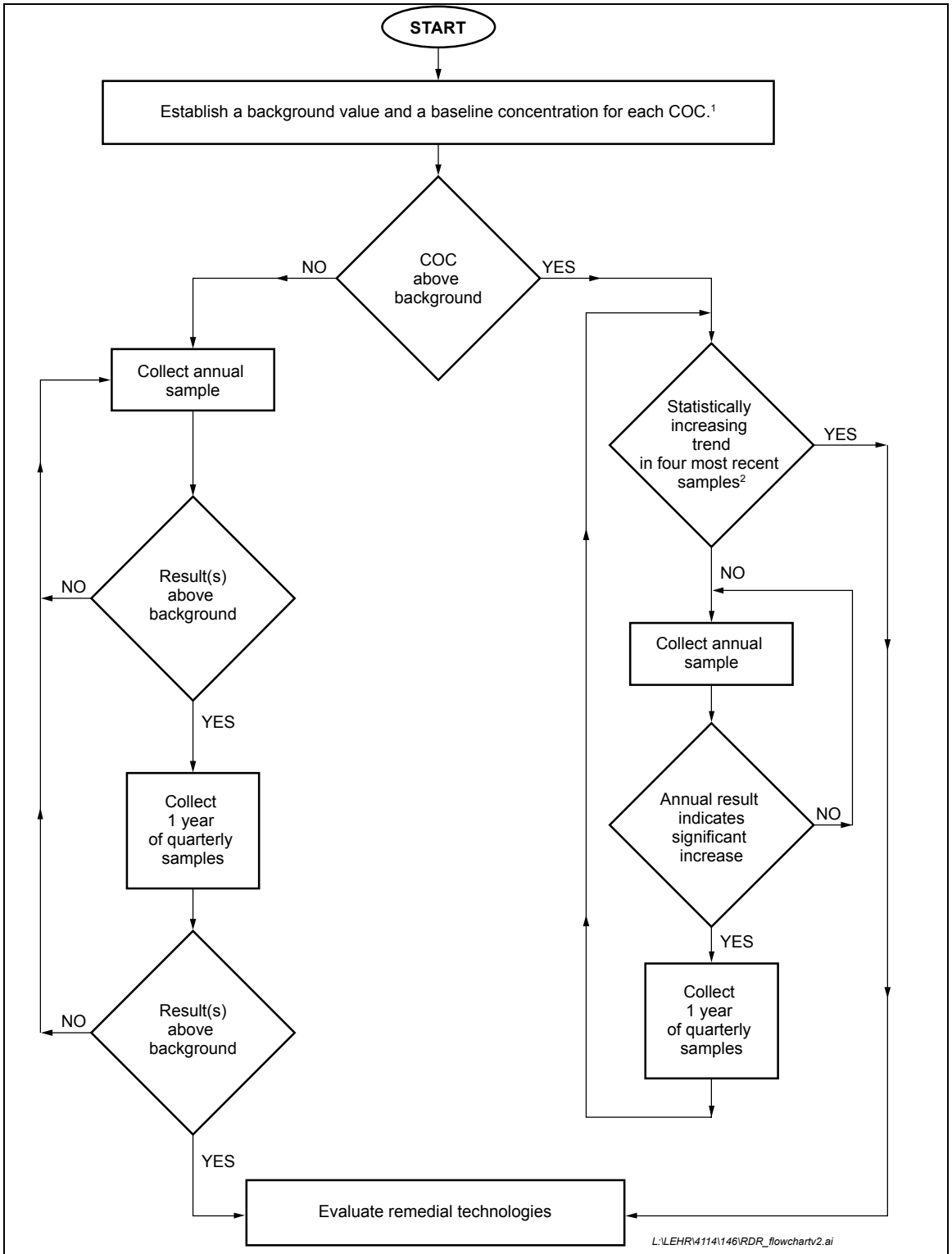


Figure 4. Groundwater Monitoring Locations



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 5. Groundwater Monitoring Decision Process

monitor potential impacts from an entire DOE area or a specific portion of the larger areas. The specific monitoring objectives for each well and the rationale for their locations are as follows:

- Wells UCD1-054 and UCD1-071 are used to monitor the concentrations of total chromium, hexavalent chromium, mercury, molybdenum, silver, cesium-137 (Cs-137), and Sr-90 (see Table 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. Well UCD1-071 is approximately 60 ft northeast of the Dry Wells area, and it is immediately adjacent to and northeast of the DSS 1 area. Well UCD1-071 is also used to monitor the concentrations of aluminum (see Table 5) downgradient of DSS 1.
- Well UCD1-021 is used to monitor the concentrations of nitrate (as N), carbon-14 (C-14), Ra-226, and americium-241 (see Table 4 and Table 5) downgradient of the Ra/Sr Treatment Systems area. Well UCD1-021 is also used to monitor the concentrations of aluminum (see Table 5) downgradient of DSS 5. Although well UCD1-021 is not ideally located for monitoring the DSS 5 area (due east approximately 130 ft), no new well is proposed specifically for monitoring aluminum from the DSS 5 area 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 deionized water extraction test results; and (3) the aluminum deionized extraction test results were similar to those for the DSS 1 area, and the DSS 1 area has a monitoring point immediately adjacent (UCD1-071). If significant aluminum impact is detected and confirmed at well UCD1-071, enhanced monitoring of the DSS 5 area will be included as part of the response. Enhanced monitoring might include increased sampling frequency, hydropunch sampling closer to the DSS 5 area, installation of a new monitoring well closer to the DSS 5 area, or another enhancement, depending on the recent aluminum results for both UCD1-071 and UCD-021. The proposed response would be presented to EPA, DTSC, the California Department of Public Health, and CRWQCB for approval before implementation.
- Well UCD1-072 is used to monitor the concentration of aluminum (see Table 5) downgradient of the DSS 6 area and monitor americium-241, C-14, Ra-226, and nitrate downgradient of the Ra/Sr Treatment Systems area. This well is located approximately 10 ft east of the DSS 6 area and approximately 45 ft east of the Ra/Sr Treatment Systems area.
- Well UCD1-069 is used to monitor the concentrations of formaldehyde, molybdenum, nitrate, aluminum, and silver (see Table 4 and Table 5) downgradient of the DSS 3 area and C-14 downgradient of the SWT area. The well location is approximately 15 ft northeast of DSS 3 and 60 ft northeast of the SWT area.
- Well UCD1-068 is used to monitor the concentrations of selenium, aluminum, chromium, and nickel (see Table 4 and Table 5) downgradient of the DSS 4 area and to supplement monitoring of the Ra/Sr Treatment Systems area. The well location is approximately 60 ft northeast of DSS 4 and approximately 150 ft northeast of the Ra/Sr Treatment Systems area.
- Wells UCD1-023 and UCD1-070 are used to monitor the concentrations of nitrate, C-14, mercury, and zinc (see Table 4 and Table 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). Well UCD1-070 is located to monitor potential impacts from the southeast corner of the SWT area, while well UCD1-023 monitors potential impacts from soil in the western portion of the SWT area.

- Well UCD1-013 is approximately 35 ft east of the EDPs area and is used to monitor the concentrations of alpha-chlordane, gamma-chlordane, and dieldrin (see Table 5) downgradient of this area.
- Wells UCD1-018 and UCD1-063 are currently used to collect background data for inorganic and radiological constituents and formaldehyde. Well UCD1-073 was installed to supplement groundwater background, but data from this well are being withheld from use due to hydraulic gradient uncertainty. DOE is currently collecting continuous groundwater level measurements at wells UCD1-054, UCD1-071, and UCD1-073 to resolve the groundwater gradient issue (see Section 3.2). The location of well UCD1-073 is approximately 100 ft west of the northwest corner of the site.
- Wells UCD1-055, UCD1-058, and UCD1-061 will be sampled starting in 2014 to provide a more comprehensive background data set for gross beta. These wells are located offsite to the northwest, beyond site impacts.

3.2 Establishing the Background Groundwater Conditions

As specified in the RD/RAWP, quarterly background samples were collected in 2011 from wells UCD1-018, UCD1-063, and UCD1-073. On January 24, 2012, the LEHR Project Team agreed to extend background sampling through 2012 and establish background from combined 2011 and 2012 data. Data from well UCD1-073 were excluded from the background determination due to groundwater flow uncertainties. Water level data loggers were installed to resolve the flow uncertainties. If data logger data collected in 2013 resolve the flow direction at UCD1-073, and data support this well as a background well, samples collected from UCD1-073 will be incorporated into the background data set at that time.

As agreed during the January 24, 2012, LEHR Team Meeting, data collected in 2011 and 2012 were combined and used to determine background; and as specified in the RD/RAWP (DOE 2010), background values were established by selecting the maximum detected value reported during the baseline period. Background values are shown in Table 8. With the exception of formaldehyde, which can occur naturally, background concentrations for organic constituents were assumed to be zero (Agency for Toxic Substances and Disease Registry 2008).

As agreed during the August 21, 2013, LEHR Team Meeting, gross beta background sampling will expand in 2014 to include wells UCD1-055, UCD1-058, and UCD1-061 (Figure 4).

3.2.1 Establishing Baseline Conditions for COCs in Groundwater

COCs were originally identified in the *Site-Wide Risk Assessment, Volume I: Human Health Risk Assessment (Part B Risk Characterization for DOE Areas)* (Weiss 2005) based on their presence in soil at levels statistically above background and at concentrations contributing to human health cancer risks above 1 in 1 million, or their potential to impact groundwater above background. The RD/RAWP identified COCs for each DOE area to be sampled during the first year of the monitoring program (DOE 2010). On January 24, 2012, The LEHR Project Team agreed to extend this sampling through 2012 and establish baseline conditions from combined 2011 and 2012 data. The sampling frequency in 2012 was biannual for some COCs and quarterly for others. The rationale for these differing sampling frequencies is documented in the

2011 Comprehensive Annual Water Monitoring Report (Weiss 2013a) and the *Final Multi-Year Water Sampling Plan* (Weiss 2013b).

Baseline concentrations were established for each COC/well pair using the combined 2011 and 2012 data. According to the RD/RAWP decision process, COCs that had concentrations above background and exhibited an increasing trend would undergo an evaluation of remedial cleanup technologies. Constituents in wells that had concentrations below background levels or that did not have an increasing trend would be sampled annually.

The results of the baseline evaluation showed that all COCs were below background or without an increasing trend (Weiss 2013c). Thus, the sampling frequency was reduced to annual for all COCs in 2013. Annual sampling will continue until the Five-Year Review unless groundwater monitoring indicates an increasing trend.

3.2.2 Monitoring-Only Constituents

A second set of constituents was identified as possibly having a very small impact on groundwater in the future (Weiss 2005). For clarity, this set of chemicals (see Table 5) is called "monitoring-only constituents" (MOCs). The RD/RAWP established annual sampling for MOCs. Results from 2011 monitoring indicated that aluminum was above background in wells UCD1-069 and UCD1-072. The LEHR Project Team agreed to sample wells UCD1-069 and UCD1-072 for aluminum twice in 2012: once during the wet season and once during the dry season. Each of the remaining 15 MOCs was below background and sampled once in 2012. Data collected in 2012 indicated two additional MOCs above background: aluminum in well UCD1-071 and zinc in well UCD1-070.

Mann-Kendall trend tests conducted on combined 2011 and 2012 data for aluminum in wells UCD1-069 and UCD1-072 indicated no increasing trend (Weiss 2013c). Mann-Kendall trend tests were not conducted for aluminum in well UCD1-071 and zinc in well UCD1-070 because three samples were collected by the end of 2012, and the minimum sample requirement for the Mann-Kendall trend test is four samples.

The sampling frequency is annual for all MOCs in 2013. Mann-Kendall trend tests will be conducted for aluminum in well UCD1-071 and zinc in well UCD1-070 when the annual sample provides sufficient data for the test.

3.2.3 New Well Constituents

The RD/RAWP specified full-suite sampling in five new onsite wells (UCD1-068 through UCD1-072) during the first two quarters after installation (first and second quarters of 2011). Twenty-five constituents exceeded background in 2011 and were termed "new well constituents" (NWCs) (i.e., constituents identified when a well is initially sampled) (Weiss 2013a). Two samples, one in the wet season and one in the dry season, were collected in 2012 for these NWCs.

NWC data from 2011 and 2012 were combined and maximum concentrations were compared to updated background values. Each constituent exceeded background in at least one sample, with the exception of copper in well UCD1-069. The copper background value increased during the

updating process; thus, the detected concentration of copper in well UCD1-069 was below background and was eliminated as an NWC.

Mann-Kendall trend tests conducted for the NWCs indicated none had an increasing trend.

Gross beta is an NWC in DOE areas wells UCD1-068 through -072. In 2012, groundwater samples were collected from wells UCD1-068 through -72 to evaluate whether potassium-40 is the source of elevated gross beta. Although potassium-40 was not detected in any of the samples, the detection limit was high and no conclusions could be drawn. Other radionuclides that may be causing elevated gross beta in DOE areas groundwater were discussed during the LEHR Project Team meeting on February 12, 2013.

Derived maximum contaminant levels (MCLs) for beta and photon emitters (EPA 2002) were presented at the August 21, 2013, LEHR Project Team meeting. The maximum gross beta concentration in DOE areas wells was below the derived MCLs for all but three radionuclides (isotopes of iodine). Two of the iodine isotopes have short half-lives and radioactive iodine isotopes have no history of use at LEHR. As a result, the Team concluded that beta-emitting isotopes are unlikely to exceed the MCL in DOE areas groundwater. The Team agreed to expand gross beta background sampling to three wells not associated with radionuclide releases and evaluate gross beta activity trends in wells UCD1-068 through -072 in the CERCLA Five-Year Review.

NWCs will be sampled once in 2013. As noted, copper is no longer above background and was eliminated from the monitoring program.

3.3 Sample Analysis and Evaluation of Groundwater Monitoring Data

Table 6 summarizes the monitoring program changes between 2012 and 2013 resulting from the RD/RAWP decision process and LEHR Project Team input. Table 7 shows the analytical parameters and sampling frequency for constituents subject to the groundwater monitoring program in 2013. The sampling plan presented in Table 7 does not extend beyond 2013 because it is subject to annual adjustment according to the RD/RAWP decision process. Split samples (field duplicates) required for this monitoring program will be collected at a minimum frequency of 10 percent, in accordance with the Quality Assurance Project Plan (QAPP) (DOE 2012). No equipment or field blanks are required because each well has dedicated sampling equipment. A trip blank will be submitted each time volatile organic compound samples are submitted to the laboratory. Table 8 specifies analytical methods, laboratory reporting limits, holding times, current background levels, and maximum contaminant level remediation goals for each analyte.

Table 8. Analytical Parameters for Groundwater Samples

Parameter	Method Reference	Container	Sample Handling/ Preservation	Holding Time	Reporting Limit[a]	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	5.86 µg/L[l]	1,000 µg/L
Chromium (total)					1 µg/L	43.7 µg/L	50 µg/L
Copper					1 µg/L	2.9 µg/L[l]	1,300 µg/L
Iron					50 µg/L	502 µg/L	NA
Manganese					1 µg/L	10 µg/L	NA
Molybdenum					1 µg/L	3.13 µg/L	NA
Nickel					1 µg/L	141 µg/L	100 µg/L
Selenium					1 µg/L	1.74 µg/L	50 µg/L
Silver					1 µg/L	< 1 µg/L	NA
Zinc					5 µg/L	20.9 µg/L	NA
Mercury	SW-846, Method 7470[b]	250-milliliter polyethylene plastic	Filter[i], nitric acid, pH<2	28 days	0.2 µg/L	0.0479 µg/L[l]	2 µg/L
Hexavalent Chromium	SW-846, Method 7199[b]	250-milliliter polyethylene plastic	Filter[i], 4 °C	24 hours	1 µg/L	40 µg/L	NA
Radionuclides							
Americium-241	EML HASL 300[c]	1-liter polyethylene plastic	Filter[i], nitric acid, pH<2	180 days	1 pCi/L	< 0.71 pCi/L	15 pCi/L
Gross Beta	EPA 900.0	1-liter polyethylene plastic	Filter[i], nitric acid, pH<2	180 days	2 pCi/L	2.88 pCi/L[l]	4 millirem/year
Cesium-137	EPA Method 901.1[d]	2-liter polyethylene plastic	Filter[i], nitric acid, pH<2	180 days	5 pCi/L	< 5 pCi/L	200 pCi/L[m]
Strontium-90	EPA Method 905.0[e]	2-liter polyethylene plastic	Filter[i], nitric acid, pH<2	180 days	1 pCi/L	< 1 pCi/L	8 pCi/L[m]
Carbon-14	EPA EERF C-01[f]	1-liter polyethylene plastic	none	180 days	7 pCi/L	< 7 pCi/L	2,000 pCi/L[m]
Radium-226	EPA Method 903.1[g]	1-liter polyethylene plastic	Filter[i], nitric acid, pH<2	180 days	1 pCi/L	1.17 pCi/L	5 pCi/L
Uranium-238	EML HASL 300[c]	1-liter polyethylene plastic	Filter[i], nitric acid, pH<2	180 days	1 pCi/L	0.946 pCi/L[l]	20 pCi/L
General							
Nitrate (as Nitrogen)	EPA Method 300.0[h]	250-milliliter polyethylene plastic	4 °C	48 hours	0.1 mg/L	15 mg/L	10 mg/L
Formaldehyde	SW-846, Method 8315[b]	1-liter amber glass	4 °C	72 hours	50 µg/L	13 µg/L[l]	NA
Organics							
1,1-Dichloroethane	SW-846, Method 8260[b]	3 each 40 ml VOA, glass	hydrochloric acid, pH<2, 4 °C	14 days	0.5 µg/L	0	5 µg/L
Benzene					0.5 µg/L	0	1 µg/L
Chloroform					0.5 µg/L	0	80 µg/L
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	0.1 µg/L
Dieldrin					0.1 µg/L	0	NA

Table 8 (continued). Analytical Parameters for Groundwater Samples

Notes:

[a] As shown, reporting limits are at or below maximum contaminant levels for all constituents except chlordane and below background levels for all inorganics except americium-241, cesium-137, and strontium-90. Reporting limits are above background levels for aluminum, mercury, uranium-238, and formaldehyde because background levels for these constituents are based on trace detections below the reporting limit.
[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.
[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] Background levels determined according to RD/RAWP procedures (DOE 2010) using 2011 and 2012 groundwater monitoring program data.
[k] Lower of California or federal primary maximum contaminant level.
[l] Background level is trace concentration (detected below the reporting limit).
[m] Beta/photon emitter derived activity yielding a dose of 4 millirem per year as defined in National Bureau of Standards Handbook 69.

Abbreviations:

EERF	Eastern Environmental Radiation Facility
MCL	maximum contaminant level
µg/L	micrograms per liter
mg/L	milligrams per liter
NA	not available
pCi/L	picocuries per liter

As shown, most of the laboratory reporting limits are sufficiently low to allow for effective comparisons with background. Aluminum, mercury, uranium-238, and formaldehyde were detected below the reporting limit (but above the method detection limit) in background samples. The uncertainty associated with background values below the reporting limit is addressed in the 2012 Comprehensive Annual Water Monitoring Report (Weiss 2013c).

As shown on Table 8, samples for metals and radionuclides (except C-14) will be filtered before analysis, as specified in the QAPP approved for groundwater monitoring (DOE 2012). 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 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 were contracted to analyze all samples. Laboratories selected to conduct these analyses are GEL Laboratories in Charleston, South Carolina, for radionuclides; TestAmerica Laboratories, Inc., in North Canton, Ohio, for formaldehyde; and CalScience Environmental Laboratories, Inc., 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 6.1, "Data Quality Objectives," Step 6). The completeness goal is per analyte per project.

A copy of the RD/RAWP decision process flowchart (DOE 2010) is shown in Figure 5. Groundwater monitoring data will be compared to background and baseline conditions as described in Section 4.0.

3.4 Reporting

Results of the monitoring program will continue to be evaluated and presented in annual water monitoring reports prepared for the site by UC Davis and in Five-Year Review reports. DOE is coordinating with UC Davis on the scope and content of the annual reports. These reports contain data evaluation, including analysis of temporal COC trends, groundwater potentiometric surface maps, and isoconcentration maps of key COCs. Additional data evaluation, such as Mann-Kendall or other statistical analyses, may also be included as appropriate and agreed to among UC Davis, DOE, and the regulatory agencies (EPA, CRWQCB, and DTSC).

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

3.5 Modifications or Termination of Groundwater Monitoring

Annual adjustments to the groundwater monitoring program will be proposed and documented in the annual water monitoring reports. As established in the RD/RAWP, if concentrations of COCs listed in Table 4 remain below background levels or are not detected for 5 consecutive years, the monitoring frequency will be reduced from annual to biannual until the next Five-Year Review. If concentrations of COCs listed in Table 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 Five-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 before implementation.

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

3.6 Quality Assurance Assessments

As discussed in Section 3.3, GEL Laboratories; TestAmerica Laboratories, Inc.; and CalScience Environmental Laboratories, Inc., have been contracted to analyze samples collected as part of the groundwater monitoring program described above. Laboratory-required reporting limits are specified in Table 8.

As required by the QAPP (DOE 2012), audits of both the field and laboratory operations associated with this groundwater monitoring program are periodically conducted. The frequency of these audits is as follows:

- **Laboratory audit:** Every 3 years, for laboratories providing ongoing analytical services, and prior to establishing a contract for any new laboratories. The next round of laboratory audits is scheduled for 2014.
- **Field audit:** Once per year during the annual groundwater monitoring event conducted by UC Davis 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 could eventually 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*. The decision process by which such an evaluation would be triggered is described below.

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 monitoring data suggest that there is an increasing concentration trend, based on the trend analysis approach described above, background concentrations will be reevaluated 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 confirmed, based on the analysis approach described above, the sampling frequency will be reduced 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.

4.2 COCs with a Baseline Concentration Below Background Levels

COCs with baseline concentrations below background levels will be monitored annually. If the annual monitoring results indicate that concentrations detected are above background levels, background concentrations will be reevaluated as a first step. Concentrations 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 concentrations have changed. If background levels have not increased, the monitoring frequency for the affected downgradient wells 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 of the *Code of California Regulations*).

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

4.3 Monitoring-Only Constituents

As discussed in Sections 1.6 and 3.4, DOE has agreed to monitor groundwater concentrations of MOCs (constituents listed in Table 5) since these constituents were identified as having a low probability of impact on groundwater in the future at the SWT area; the Ra/Sr Treatment Systems area; the DSS 1, 3, 4, 5, and 6 areas; the Dry Wells A–E area; and the EDPs area.

If any MOC is confirmed above background, response actions will be evaluated and implemented in accordance with CERCLA and ARARs (DOE 2009b).

4.4 New Well Constituents

Annual samples will be collected in 2013 for the 24 NWCs that were above background. The 2013 data will be compared to background and tested for trends. If constituents are confirmed above background and increasing in the new wells, their source will be evaluated to assess whether they originate from DOE areas. If DOE areas are the source, response actions would be evaluated and implemented in accordance with CERCLA and ARARs identified in the ROD (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). This LTS&MP defines DOE's responsibilities. 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 LTS&MP:

- 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.
- 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 areas on the site according to the ROD requirements.

5.3 Key Personnel

Cliff Carpenter, 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 the installation of monitoring wells, annual reporting,

Five-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 holding key positions at UC Davis are as follows:

- **Executive sponsor:** Jill Blackwelder (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:** Tim Utterback (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 holding key positions at Stoller are as follows:

- **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:** Tim Utterback (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:** Linda Tegelman (Stoller)
- **Project chemist:** Brian Bandy (Weiss Associates)
- **Occurrence coordinator:** Linda Tegelman (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 3.4), depending on whether the personnel changes affect 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 5.5). 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, CA 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 Programs," 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 (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.

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6.0 Quality Assurance

This section provides guidance to project personnel in implementing the QAPP (DOE 2012) and associated Standard Quality Procedures (SQPs) as they apply to the remedial action activities described in this LTS&MP. The QAPP may be obtained from the UC Davis Environmental, Safety, and Health Unit.

6.1 Data Quality Objectives

Data quality objectives (DQOs) for the remedial action activities are documented in the RD/RAWP (DOE 2010). Revisions or updates to the DQOs require LEHR Project Team agreement. The DQOs will be reviewed and revised, if necessary, during the Five-Year Review.

6.2 Roles and Responsibilities

The roles and responsibilities of key personnel are described in Section 2.1 of the QAPP, and the personnel currently filling key positions are presented in Section 5.3. Project personnel can delegate the execution of, but not the responsibility for, their quality-affecting tasks to other qualified project personnel at any time. Key personnel can 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.

6.3 Personnel Training and Qualification

Before the start of any activities covered by this LTS&MP, personnel training and qualification will be conducted and evaluated in accordance with Section 5 of the QAPP and SQP 3.2, “Indoctrination and Training.”

6.4 Field Documentation and Records Management

All quality-affecting records generated during activities covered by this LTS&MP 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 personal field logs, calibration records, monitoring data, inspection checklists, sampling documentation, and procurement records.

6.5 Test Control

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

6.6 Design Control

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

6.7 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.

6.8 Field Sampling

Field sampling will conform to the requirements of (1) Section 3.0 of this LTS&MP and (2) Section 8 of the QAPP.

6.9 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."

6.10 Data Quality Assessment

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, Standard Operating Procedures (SOPs), 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:
  - Establishing baseline conditions for COCs in onsite groundwater (see Section 3.2.1).
  - Determining concentration trends for COCs that are established as above background in groundwater (see Section 4.1).
  - Comparing concentrations to background for COCs that are established as below background (see Section 4.2).
  - Determining concentration trends for constituents (non-COCs) identified as having a low probability of impact on groundwater (see Section 4.3).
- Undertake remedial action to prevent the degradation of water quality.

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. The relative percent difference is used to determine whether a significant difference exists among 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.

The main parameters used to assess accuracy are matrix spike recovery and laboratory control sample spike recovery.

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

Data representativeness will be achieved through sampling of groundwater monitoring wells that represent background and onsite conditions. In 2011 and 2012, samples were collected from three background wells and nine onsite wells. The background wells are screened in the same HSU as onsite wells to gain background data that are generally representative of onsite conditions in the absence of impacts from DOE activities.

Samples collected from background well UCD1-073 in 2011 and 2012 were not used due to groundwater flow uncertainties. Continuous water level monitoring was implemented in 2012 to verify whether UCD1-073 is a viable background well. Improved control of data logger drift was implemented in 2013 to fully resolve the flow direction. Data from well UCD1-073 will be used to represent background if water level monitoring data verify that it is upgradient of the LEHR site.

The onsite wells are in proximity to each DOE area with residual soil contamination subject to monitoring. The rationale for using each monitoring well 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. 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 are determined using individual maximum concentrations to represent population data. COCs and MOCs determined during the baseline assessments to be below background are 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 might not be accurate. Qualified data are generally usable in statistical evaluations that include a sufficient

number of samples, but project decisions might not be well supported when based on a single qualified result. The reason for the data qualification and its impact on the decision should be taken into consideration for any 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 is 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 or the selection of the next-highest concentration might 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 are also established using maximum concentration data. The same procedure as that stated above for establishing background condition is used. If the maximum concentration is qualified, or determined to be an outlier, additional samples may be collected 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 re-collection 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 MOCs to site background values:** The results of annual samples of MOCs 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 exceed 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 to the procedures in Chapter 6 of *Methods for Evaluating the Attainment of Cleanup Standards*, *Volume 2: Ground Water* (EPA 1992), or in accordance with 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:

H_o: There is no trend.
H_a: 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 the width of the gray region is a parameter 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 background wells and the relevant onsite wells. The round of samples will be collected before taking actions such as increasing the sampling frequency or evaluating 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 Table 8. 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 reanalyzed 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.

6.11 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, a review of project documentation, or both. All observations, findings, and supporting documentation that result from the inspections and audits will be summarized in the appropriate report format and submitted to the project file.

6.12 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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Abbreviations

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
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
LTS&MP	Long-Term Surveillance and Maintenance Plan
MDL	method detection limit
MOA	Memorandum of Agreement
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
PCBs	polychlorinated biphenyls
pCi/g	picocuries per gram
Ra/Sr	Radium/Strontium
ROD	Record of Decision
RPD	relative percent difference
SMP	Soil Management Plan
SWRA	Site-Wide Risk Assessment
SWT	Southwest Trenches
UC	University of California
UC Davis	University of California, Davis
UCL	upper confidence limit
UTL	upper tolerance limit
WDPs	Western Dog Pens
WRS	Wilcoxon Rank Sum

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A1.0 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 Long-Term Surveillance and Maintenance Plan (LTS&MP), 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), that generate de minimis amounts of soil (5 cubic yards or less), and that do not require offsite disposal are not subject to the requirements of this plan.

A1.1 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.

A1.1.1 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 area; a waste burial area known as the DOE Disposal Box; onsite 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 DSS 6 areas (Figure A-2).

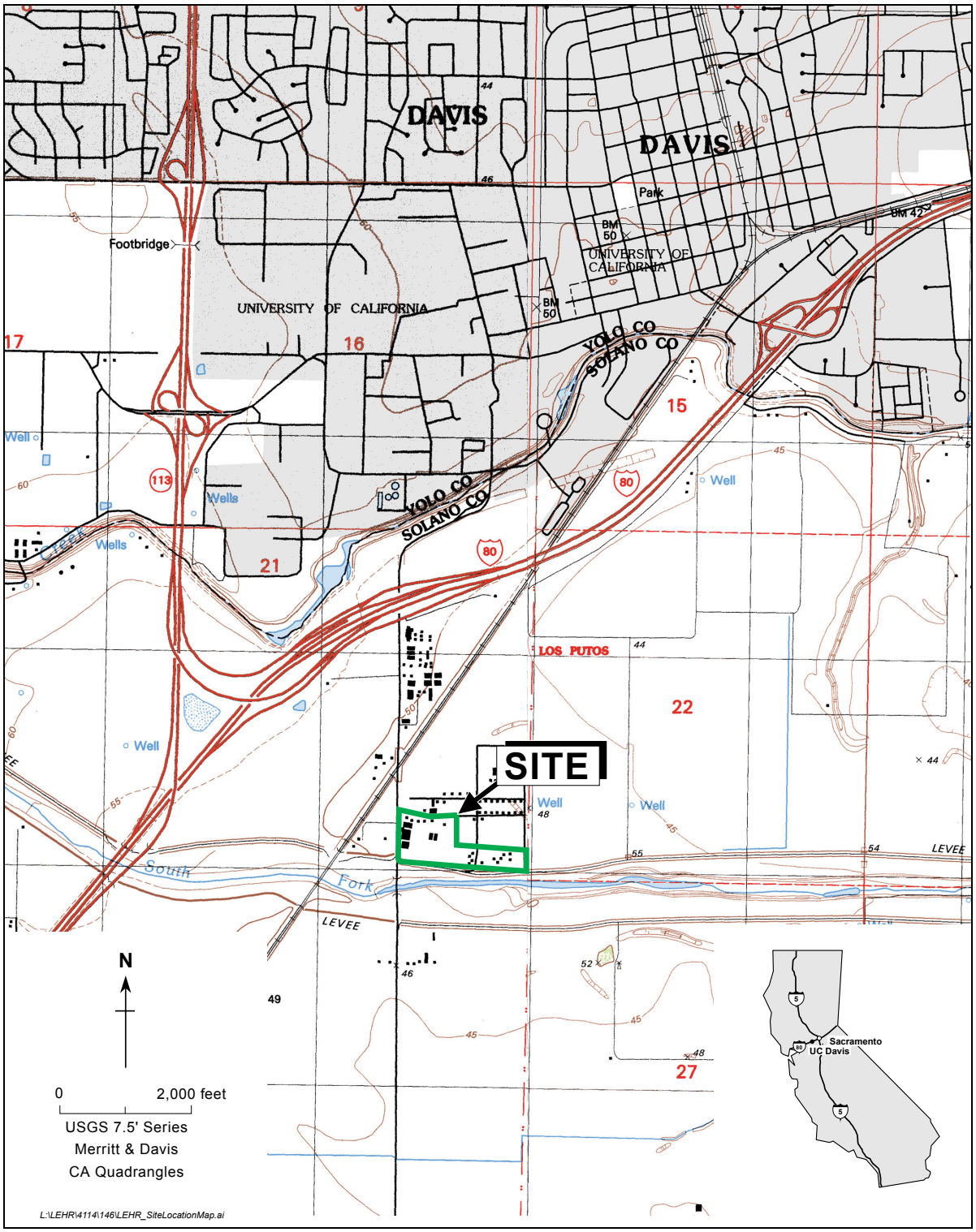

Figure A-1. Location of the LEHR Site, UC Davis, Solano County, California

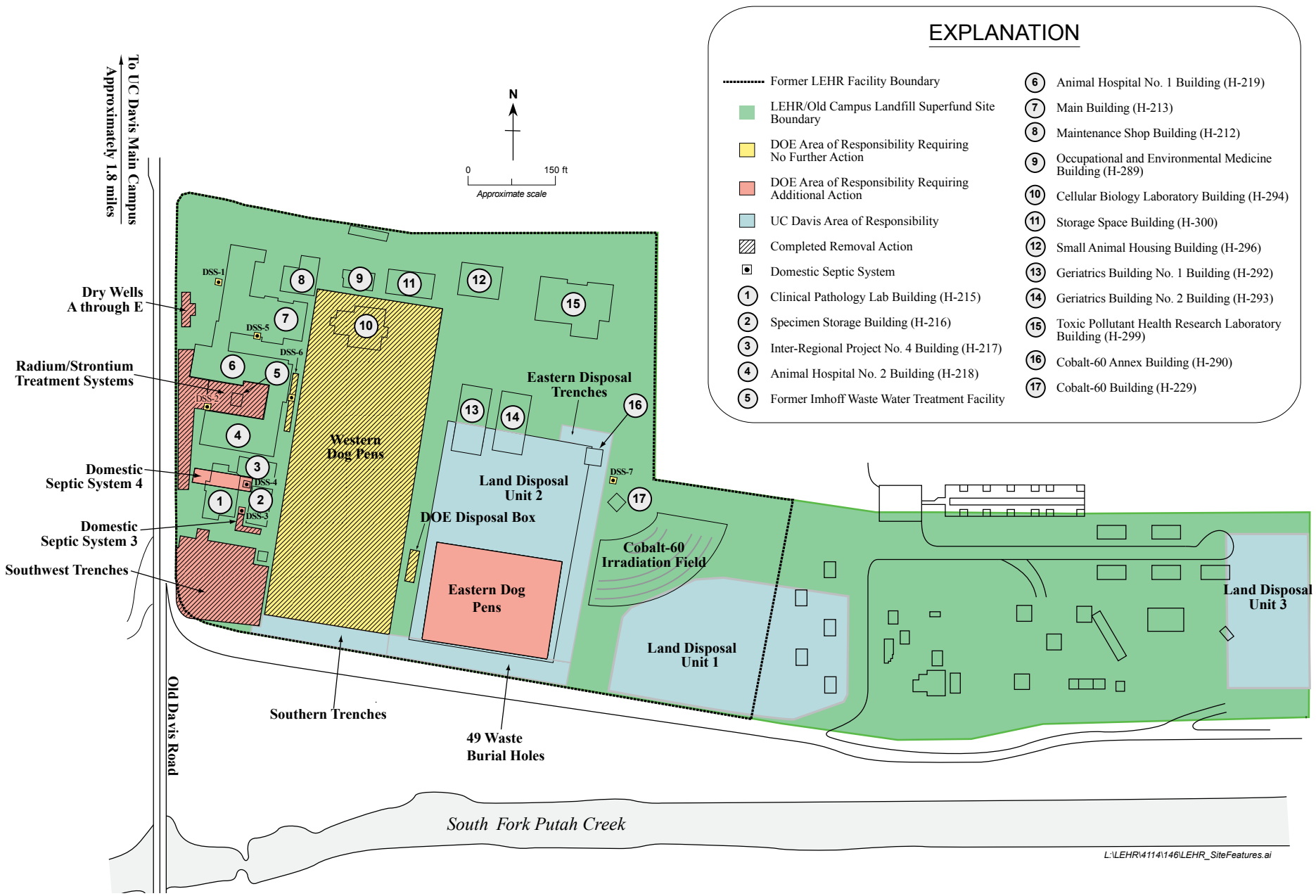

Figure A-2. LEHR Site Features

A1.1.2 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 area, 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.

A1.1.3 Areas Requiring Additional Action

The following areas (see Figure A-3) 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:

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

A1.1.4 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, the DSS 3 area, the Dry Wells A−E area, and the SWT area.
- Long-term groundwater monitoring with contingent remediation, a land-use restriction prohibiting residential use, and an SMP at the DSS 4 area.

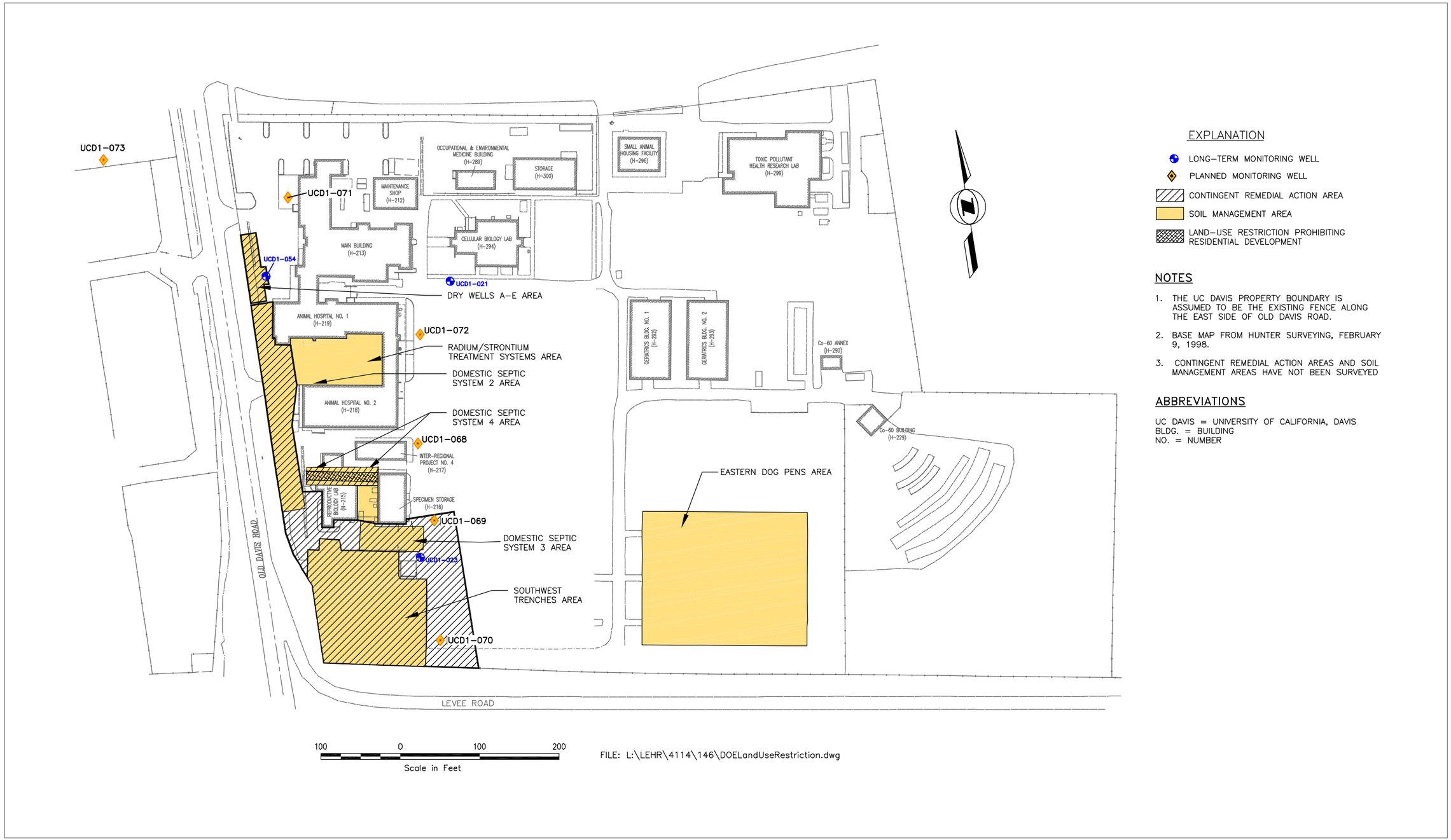

Figure A-3. DOE Areas at LEHR Subject to Land-Use Controls, Including Soil Management

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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 remedies are described in the LTS&MP, and include the development and implementation of this SMP (which is an appendix to the LTS&MP) to specify controls that would apply to activities that disturb the subsurface. The general requirements of the LTS&MP and this SMP shall be documented in recorded land-use covenants.

A1.2 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.

A1.3 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.

A1.4 Organization

This SMP contains the following:

- 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
- Recordkeeping and reporting requirements

A1.5 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.

A1.5.1 Excluded Activities

This plan does not apply to DOE areas that require no action or no further action (see Section A1.1.2 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.

A1.6 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.

A1.7 Revisions

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

A2.0 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 A2.2.2.1) will implement the requirements of this plan, with DOE retaining ultimate accountability for compliance with the requirements of the ROD that this SMP executes.

A2.1 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.

A2.1.1 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 the LTS&MP, which states how the requirements of the ROD and remedial implementation work plans and the 5-year review findings shall be met. The LEHR LTS&MP defines the requirements for managing and containing soil at the site.

As part of the implementation of the LTS&MP, the Office of Legacy Management is responsible for (1) 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 (2) conducting 5-year reviews as required by the ROD.

A2.2 University of California

A2.2.1 UC Regents

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

- 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)

A2.2.2 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.

A2.2.2.1 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 LTS&MP. The EH&S Unit shall develop and maintain internal policies and procedures to ensure that the following:

- This SMP and other land-use restrictions are implemented
- The DOE areas are visited to verify that all land-use restrictions are maintained
- 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 A2.3), 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 LTS&MP, the Remedial Design/Remedial Action Work Plan, the ROD, or the MOA between DOE and the UC Regents.

A2.2.2.2 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 it must 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.

A2.3 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.

A3.0 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 A1.1.1, DOE removed all waste from the DOE areas at LEHR. Small quantities of several contaminants remain in the soil. All contaminants present in soil above

background concentrations should be considered when soil is evaluated for onsite reuse or offsite 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 a 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 onsite resident was below this threshold at the DSS 3, Dry Wells A–E, and Ra/Sr Treatment Systems areas. The risk assessments also indicated that the potential risk to onsite construction workers was less than 1 in 1 million at the DSS 3 area; the Dry Wells A–E area; and the Ra/Sr Treatment Systems, SWT, and EDPs areas.

The risk calculations were based on conservative assumptions. Risk to a hypothetical onsite resident was based on exposure to soil through direct dermal contact, ingestion, inhalation of soil particulates, ingestion of homegrown 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 onsite resident was above 1 in 1 million for some contaminants at the DSS 4, EDPs, and SWT areas. The highest risk to the hypothetical onsite 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). Onsite construction workers were estimated to have a 1-in-1-million risk from benzo[*a*]pyrene in subsurface soil at the DSS 4 area. 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, DSS 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
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).
WRS = Wilcoxon Rank Sum

A4.0 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 A5.0 discusses emergency work.

A4.1 Pre-Excavation and Pre-Construction Activities

A4.1.1 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 will 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 will 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, offsite 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 the 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.

A4.1.2 Project Evaluation and Site Inspection

An evaluation of the proposed project will be conducted by the EH&S Unit and an environmental professional. It will consist of a review of all available data, including survey maps and the contaminant distribution data provided in this SMP (Section A3.0 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 the environmental professional in the soil management planning process. Information regarding residual contamination distribution

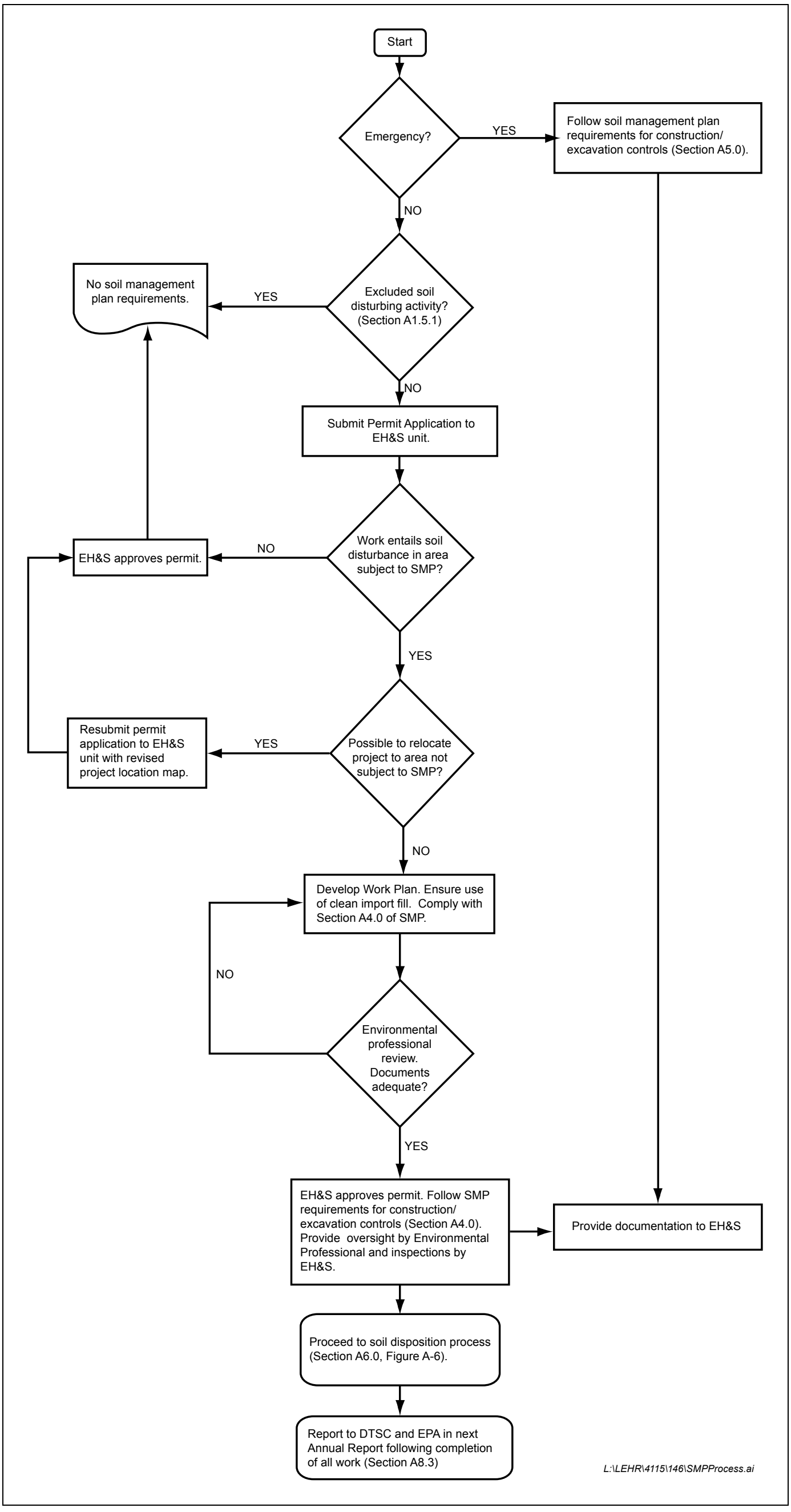

Figure A-4. Process for Conducting Non-emergency Work at the DOE Areas of the Laboratory for Energy-Related Health Research

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and fate and transport is included in the Risk Characterization report (Weiss 2005), which is available 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.

A4.1.3 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 who are authorized and trained to work there.

A4.1.4 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 (29 CFR 1910.120) and Title 8 *California Code of Regulations* Section 5192. 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.

A4.1.5 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.

A4.1.5.1 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.

A4.1.5.2 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 to meet the needs of the waste disposal facility in the case of offsite disposal.

A4.1.5.3 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.

A4.1.6 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.

A4.1.7 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.

A4.1.8 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, the following:

- 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.

A4.1.9 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 an 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.

A4.1.10 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 offsite 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 downwind 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;
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.

A4.1.11 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 the following:

- 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 by 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

A4.1.12 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.

A4.1.13 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.

A4.2 Imported Soil Backfill

Soil for backfill may be imported from either onsite or offsite 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,
- Mercury by SW846 Method 7470,
- Volatile organic compounds by SW846 Method 8260,
- Semivolatile organic compounds by SW846 Method 8270,

[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.

- 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 or laboratories that will conduct the analyses, and will provide the Quality Assurance Plan, the 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 onsite or offsite sources.

A5.0 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 A6.0 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 A4.2 above.

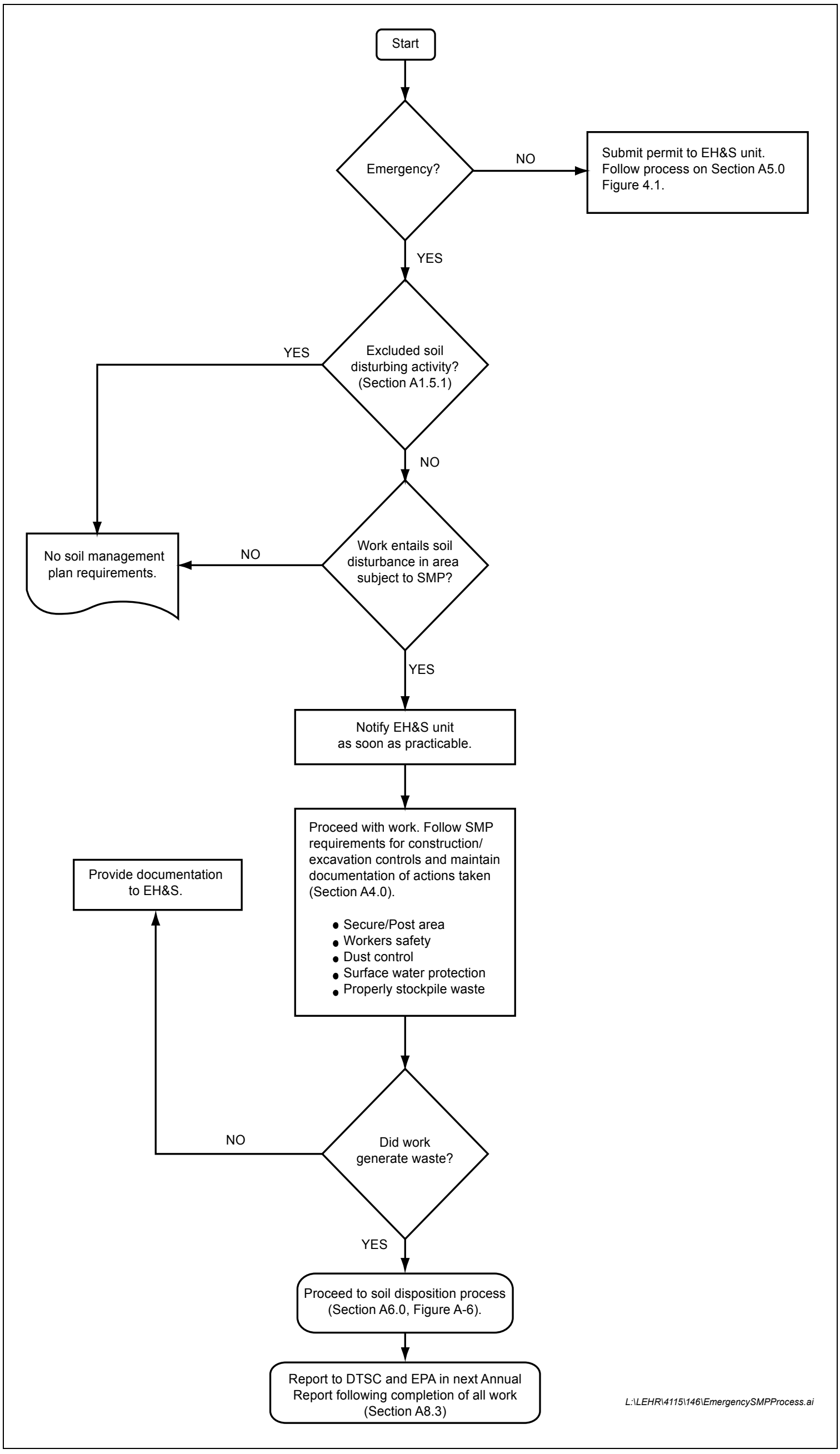

Figure A-5. Process for Conducting Emergency Work at the DOE Areas of the Laboratory for Energy-Related Health Research

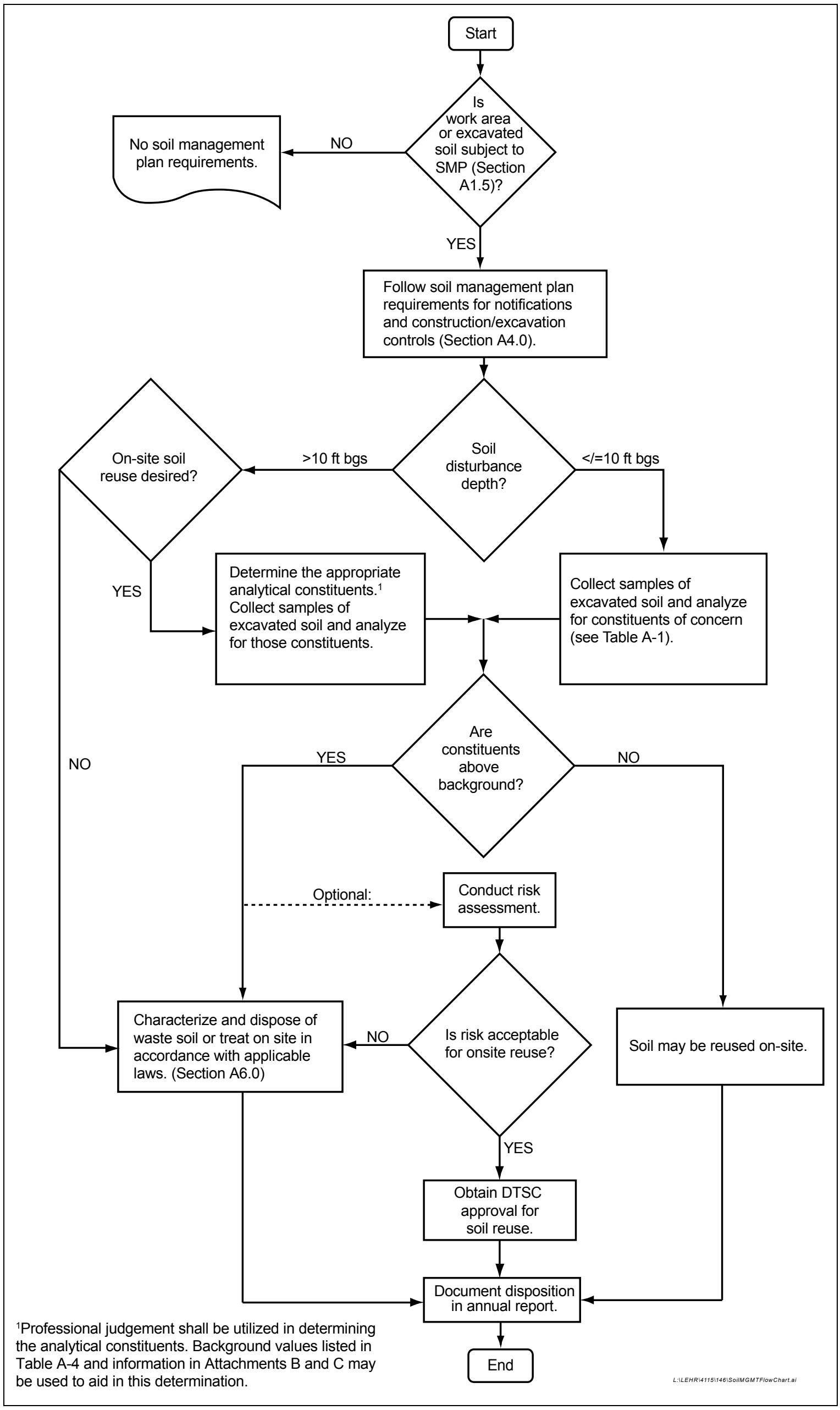

Figure A-6. Decision Process for Disposal of Excavated Soil

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
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

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 A6.0.

A6.0 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 the proper disposal of excavated soils. 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.

A6.1 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 with 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.

A6.2 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 A6.1). 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.

A6.2.1 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.

A6.2.2 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 might 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, might 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 offsite for disposal or evaluated for onsite reuse. A depth-specific evaluation of existing data can 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 might 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 or laboratories that will conduct the analyses, and will provide the laboratory's or laboratories' 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.

A6.2.2.1 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. 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 do the following:

- 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

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 A4.1.5) 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).

To support future soil management decisions, the completeness goal for samples collected shall be 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 might 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 might 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 (UCL) on the mean, 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 or 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, an 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 as follows:

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
"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 (i.e., 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.

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
4,4'-DDD	3.3	EDPs, SWT

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

Analyte	Required Detection Limit (µg/kg)	DOE Area
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

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.
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 data quality objective performance/acceptance criteria and initiate corrective action, if necessary, to prevent future occurrences.

A6.2.3 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 might 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.

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*

Additional sample collection might be necessary to meet the statistical power requirement of the test. Statistical tests generally require at least five samples.

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

A6.3 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 offsite 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 might require specific analytical testing to document that chemical concentrations do not exceed their waste acceptance criteria.

A6.3.1 Clean Soil

Clean excavated soil will be reused on site (such as for fill or other construction purposes) to the extent practicable. If onsite reuse is not practical or cost-effective, clean waste soil will be disposed of in a qualifying landfill (see Section A6.3 above).

A6.3.2 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 must not have any added radioactivity (i.e., above activities found in background soils). The landfill might require

analytical testing of the soil to document that chemical concentrations do not exceed the landfill's waste-acceptance criteria.

Nonhazardous soil can 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 onsite 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 or equivalent). DOE, DTSC, and EPA shall approve the risk assessment before the soil is reused. The soil must be reused in accordance with the risk assessment assumptions.

A6.3.3 Hazardous, Radioactive, or Mixed Waste Soil

Soil classified as hazardous and/or containing added radioactivity that fails the risk assessment for reuse on site can be treated on site or be shipped offsite 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.

Onsite treatment shall be conducted only with agency approval and must meet the requirements of the Site Treatment Plan and all applicable laws. Onsite treatment may be performed to reduce waste toxicity or consolidate volume prior to disposal. If contaminated soil is disposed of at an offsite 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 offsite 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 offsite.

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 is 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.

A7.0 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.

A8.0 Documentation

A8.1 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

A8.2 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 the following:

- 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 offsite disposal facilities
- Volumes of soil reused on site along with surveyed coordinates indicating the location(s) where such soil was placed
- Analytical data for an imported soil placed on site

A8.3 Annual Reports

Per the requirements of the ROD and as described in the LTS&MP, 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 the following:

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

These reports shall discuss SMP implementation and summarize the data and information described in Sections A8.1 and A8.2 above.

A8.4 Audits

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

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

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

A8.5 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 LTS&MP, as well as any regulations, policies, and guidance applicable at the time. Any recommended SMP modification will be addressed during these reviews.

A9.0 References

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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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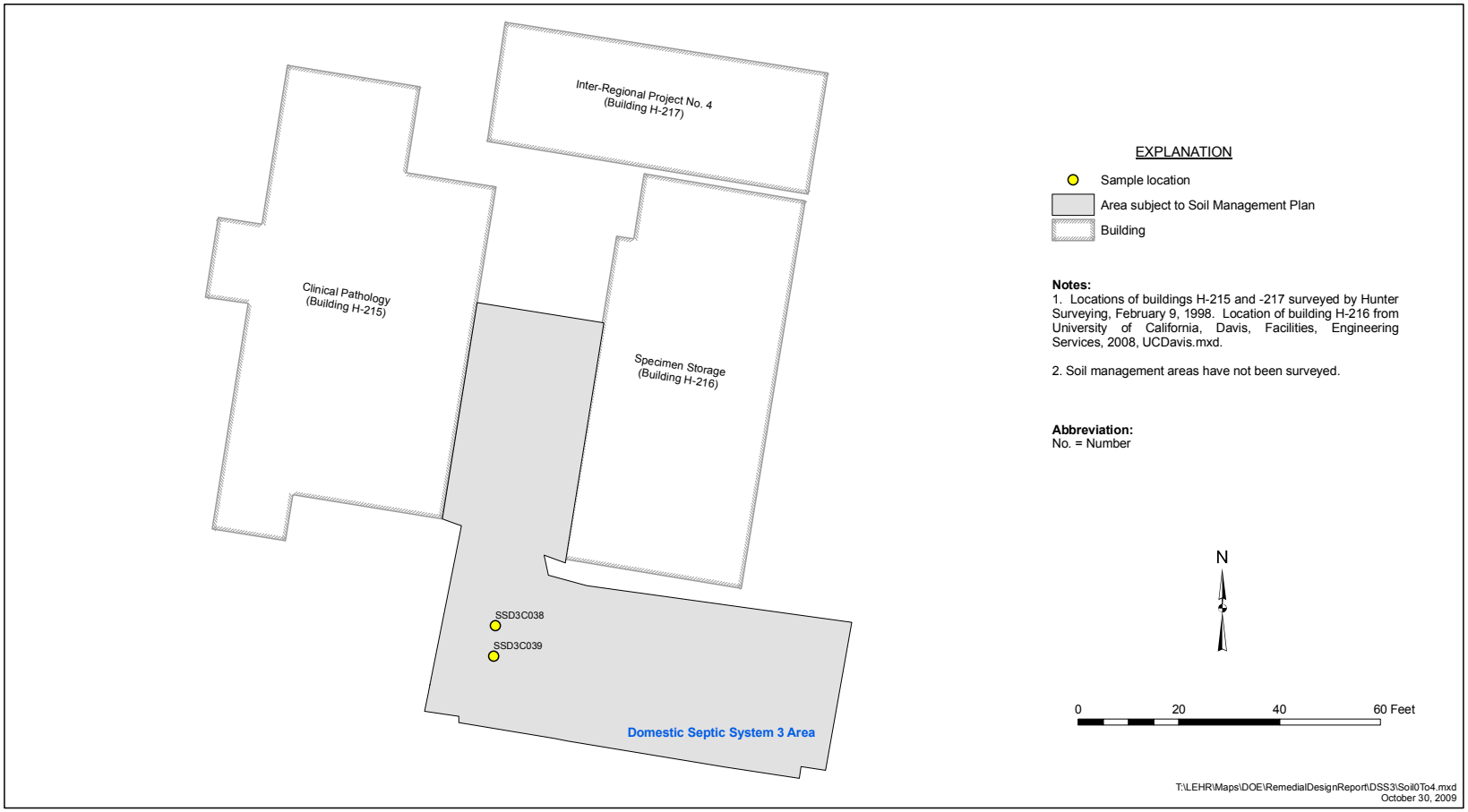
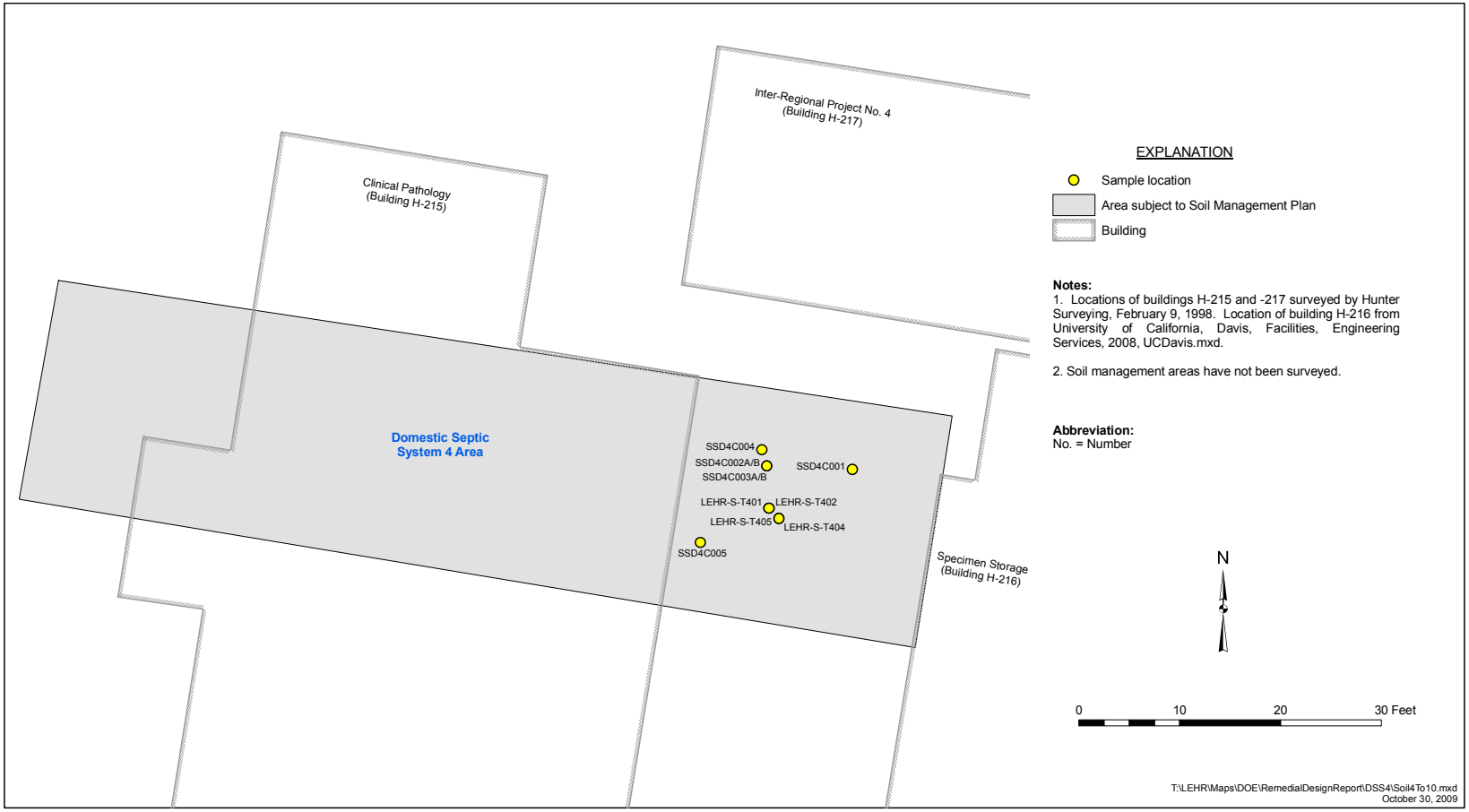


Attachment B Figure 1. Soil Sample Locations for the Domestic Septic System 3 Area (0 to 4 Feet Below Ground Surface)

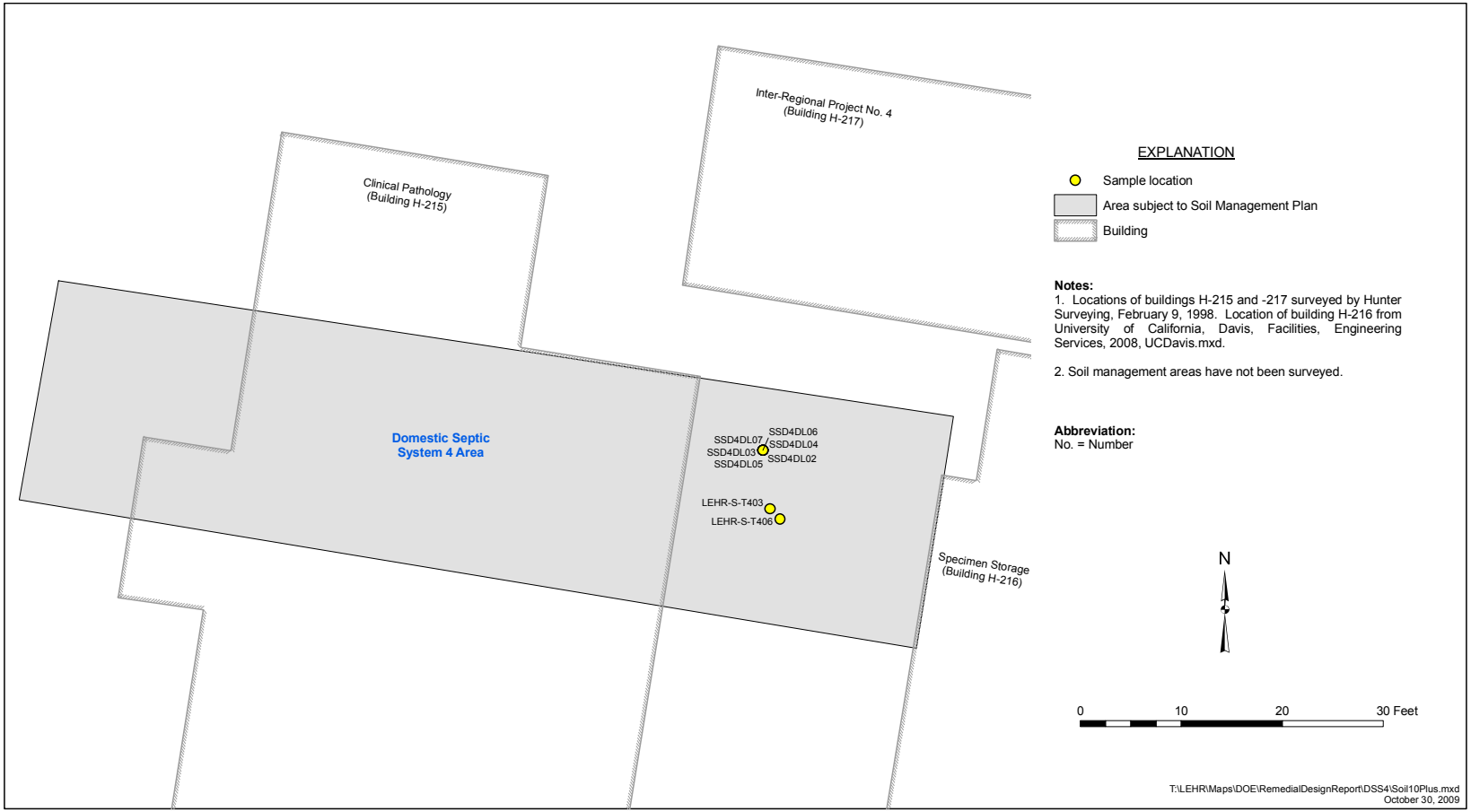
Attachment B Figure 2. Soil Sample Locations for the Domestic Septic System 3 Area (>4 to 10 Feet Below Ground Surface)

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

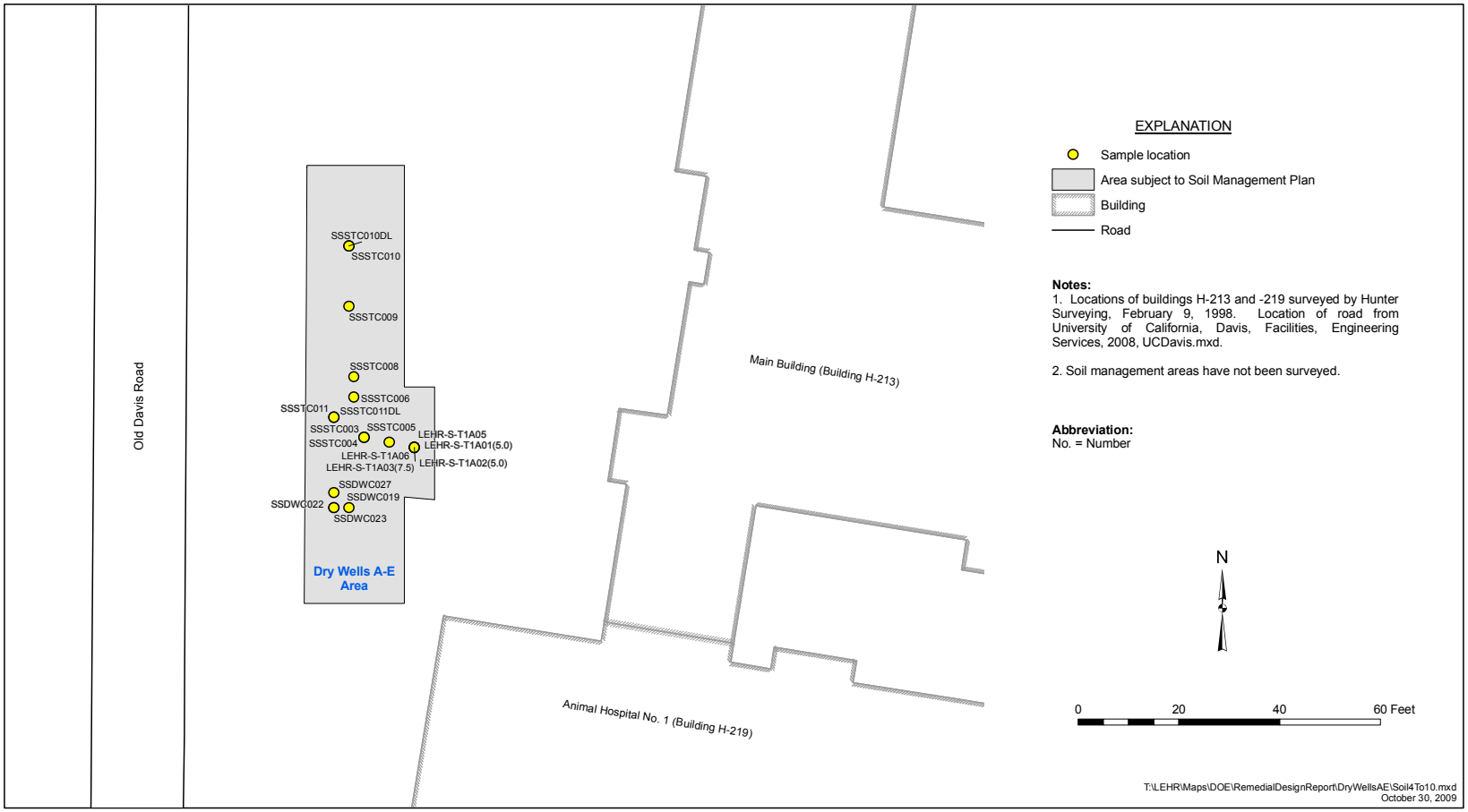


Attachment B Figure 4. Soil Sample Locations for the Domestic Septic System 4 Area (>4 to 10 Feet Below Ground Surface)

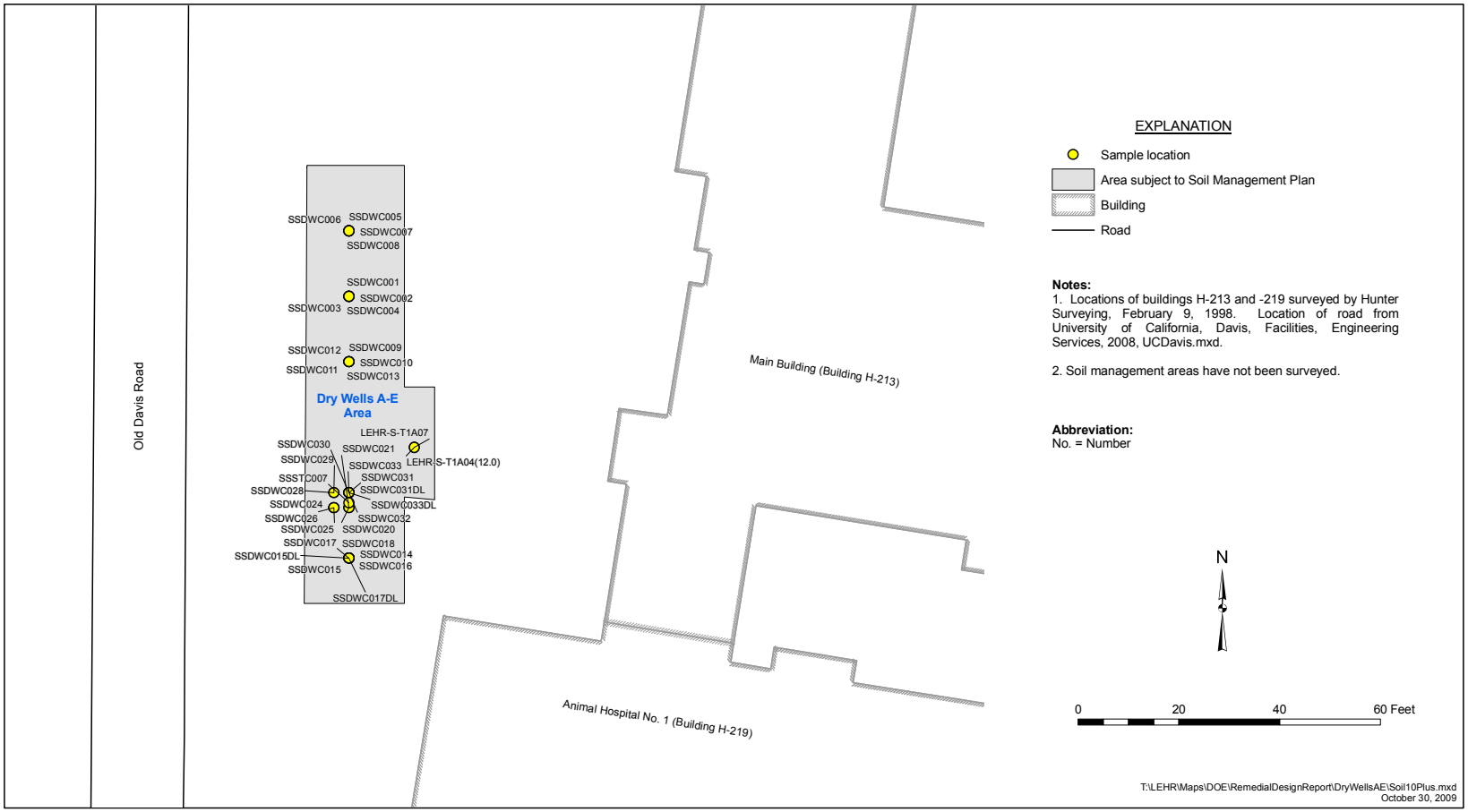
Note: No sample data exists for soil beneath Building H-215. Contamination similar in nature to that reflected by existing sample data near the building should be expected.



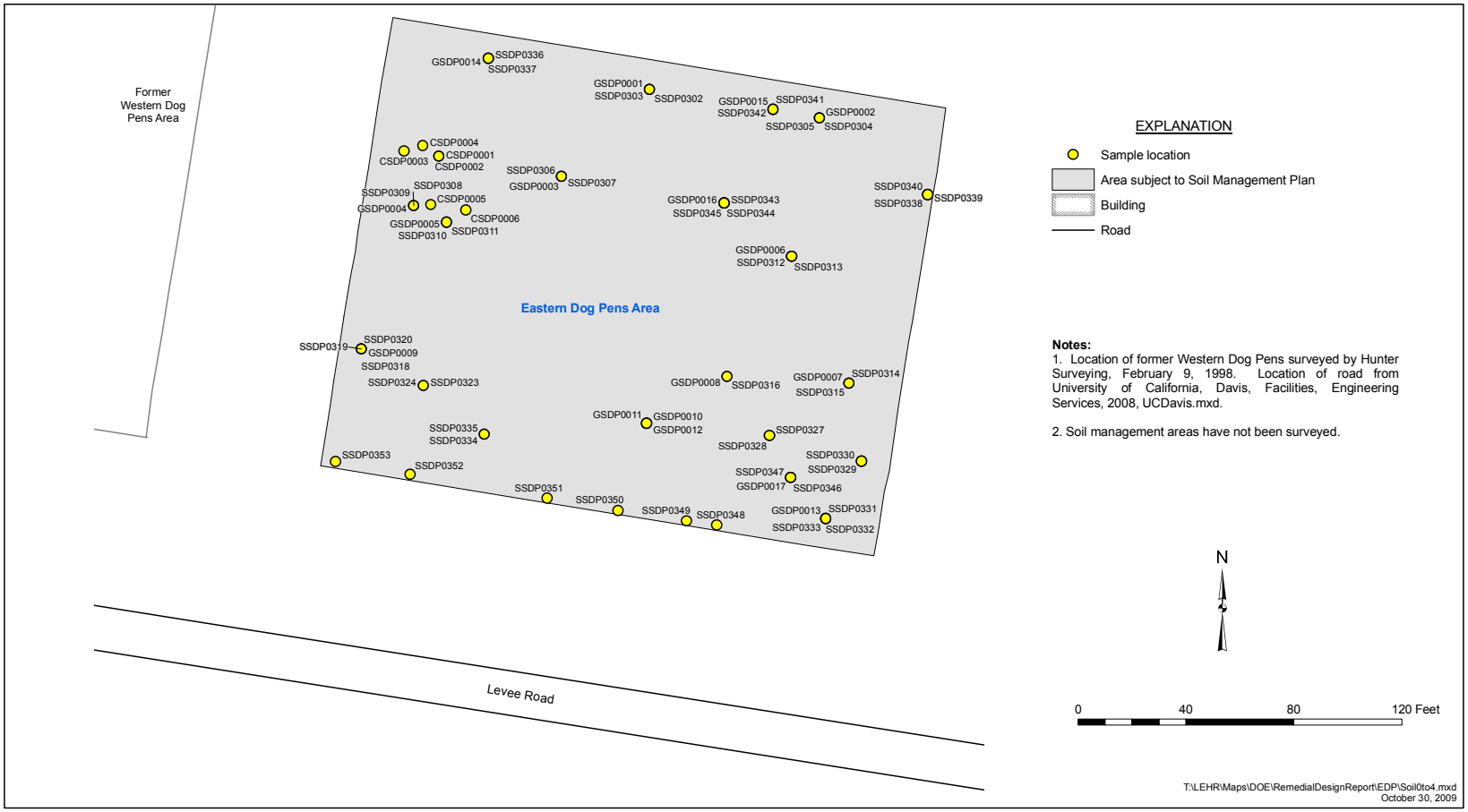
Attachment B Figure 5. Soil Sample Locations for the Domestic Septic System 4 Area (>10 to 37.8 Feet Below Ground Surface)



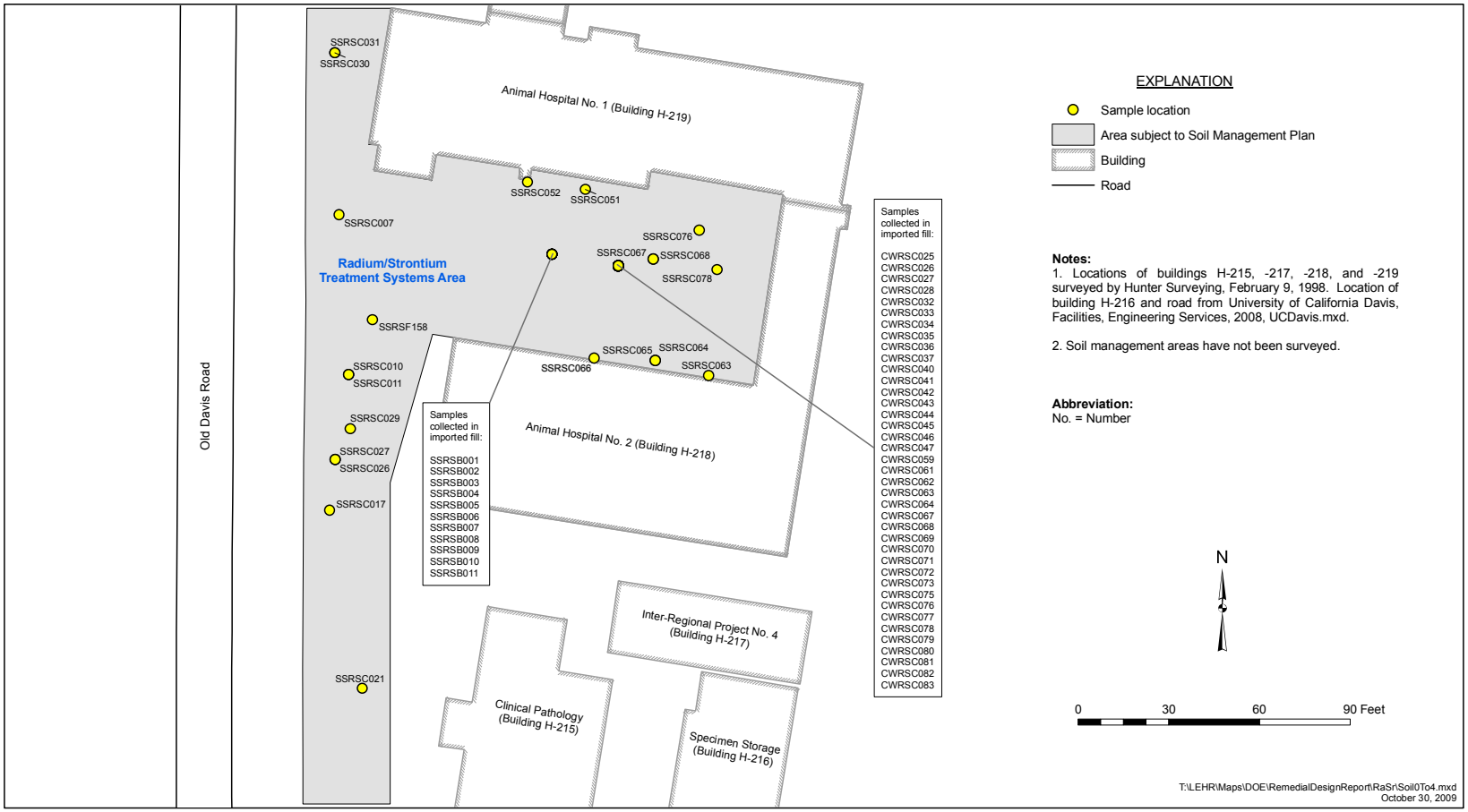
Attachment B Figure 6. Soil Sample Locations for the Dry Wells A–E Area (>4 to 10 Feet Below Ground Surface)



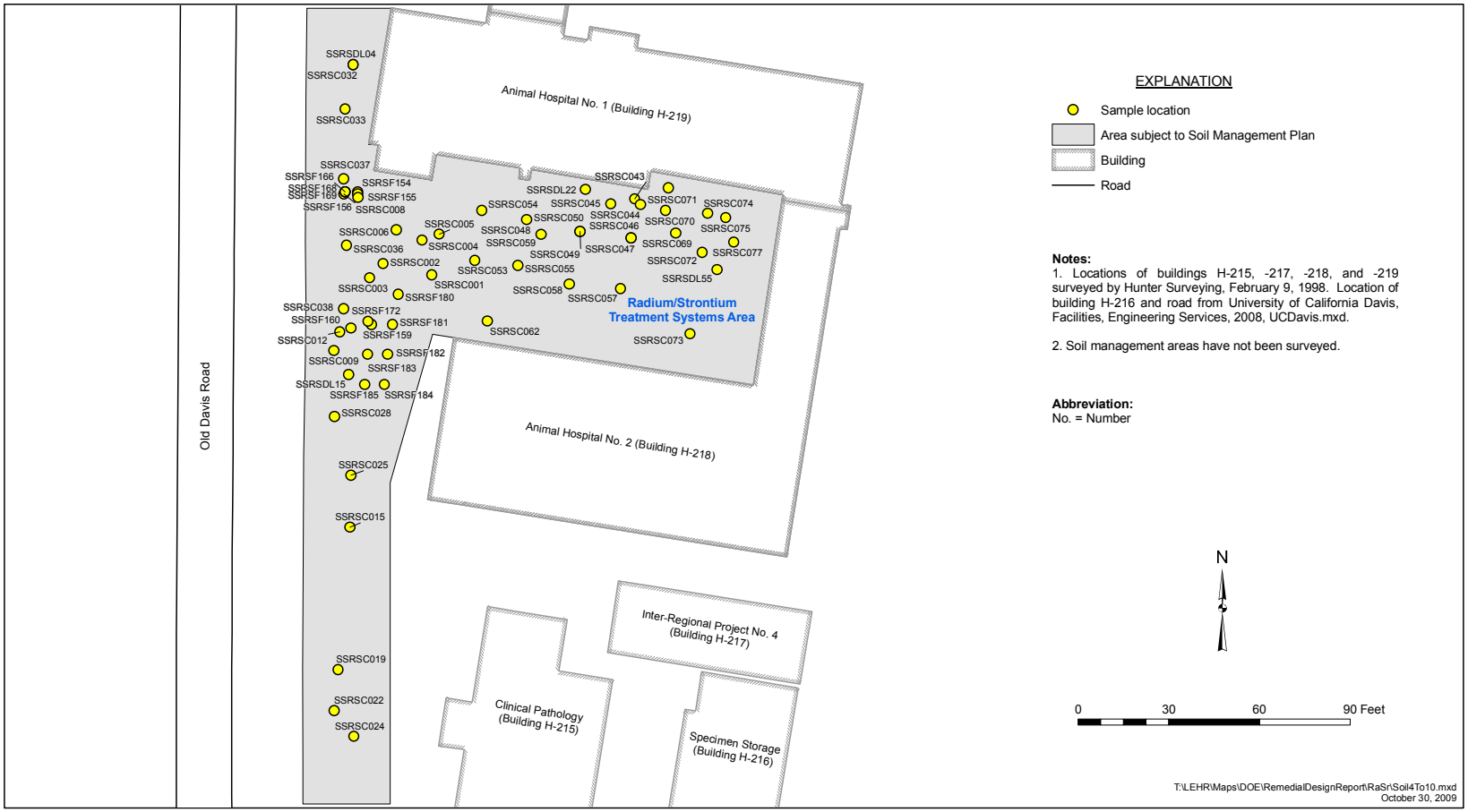
Attachment B Figure 7. Soil Sample Locations for the Dry Wells A–E Area (>10 to 40 Feet Below Ground Surface)



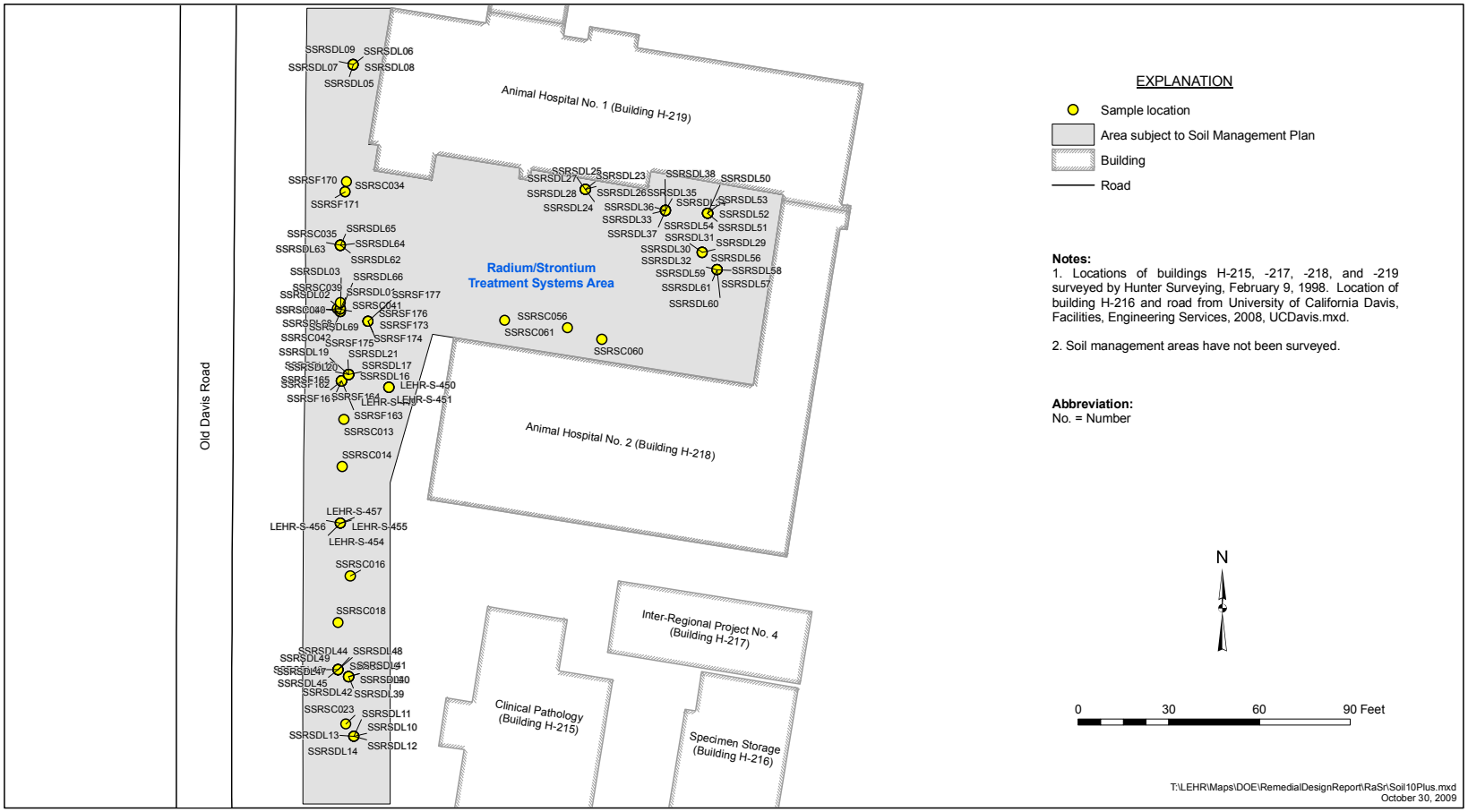
Attachment B Figure 8. Soil Sample Locations for the Eastern Dog Pens Area (0 to 4 Feet Below Ground Surface)



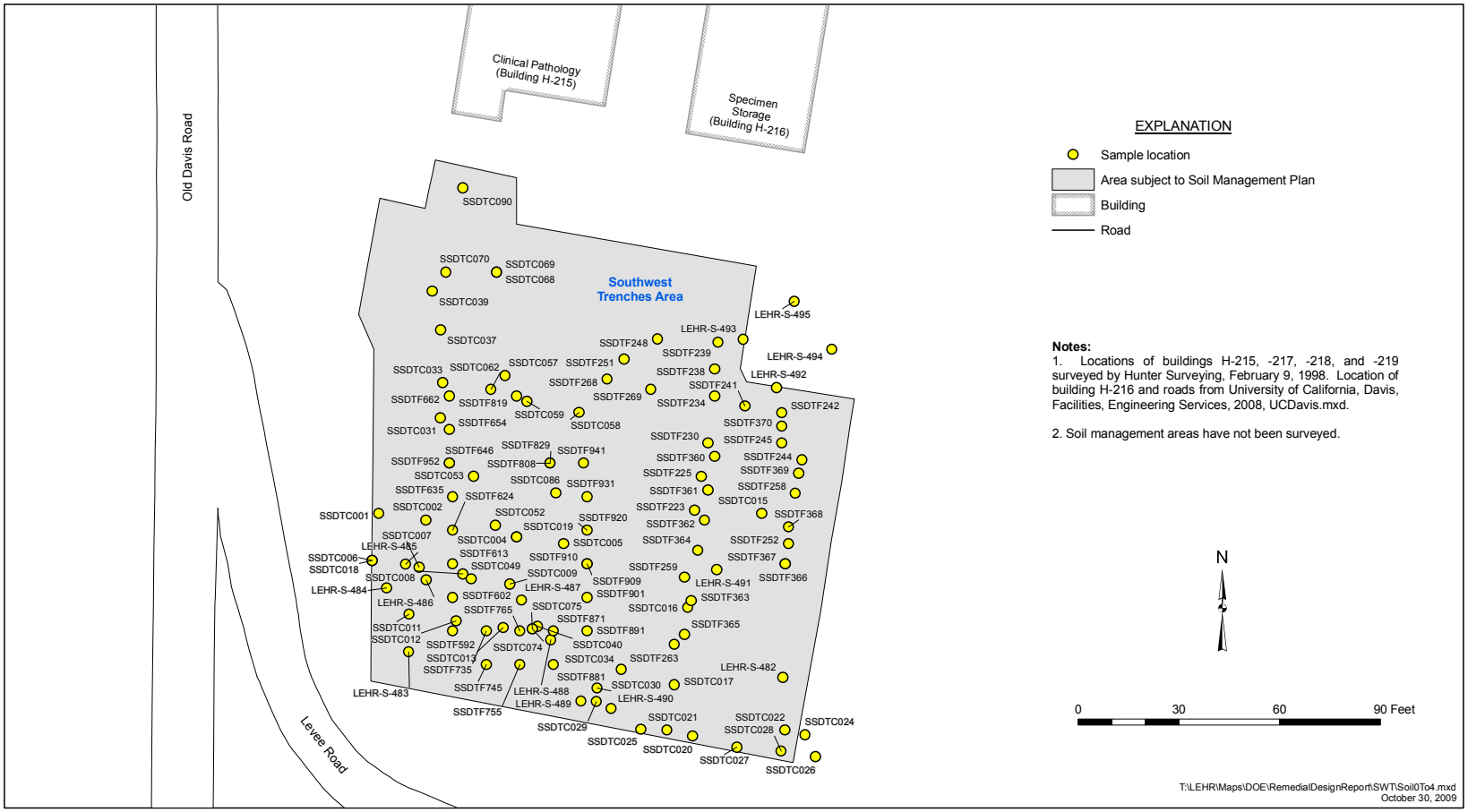
Attachment B Figure 9. Soil Sample Locations for the Radium/Strontium Treatment Systems Area (0 to 4 Feet Below Ground Surface)



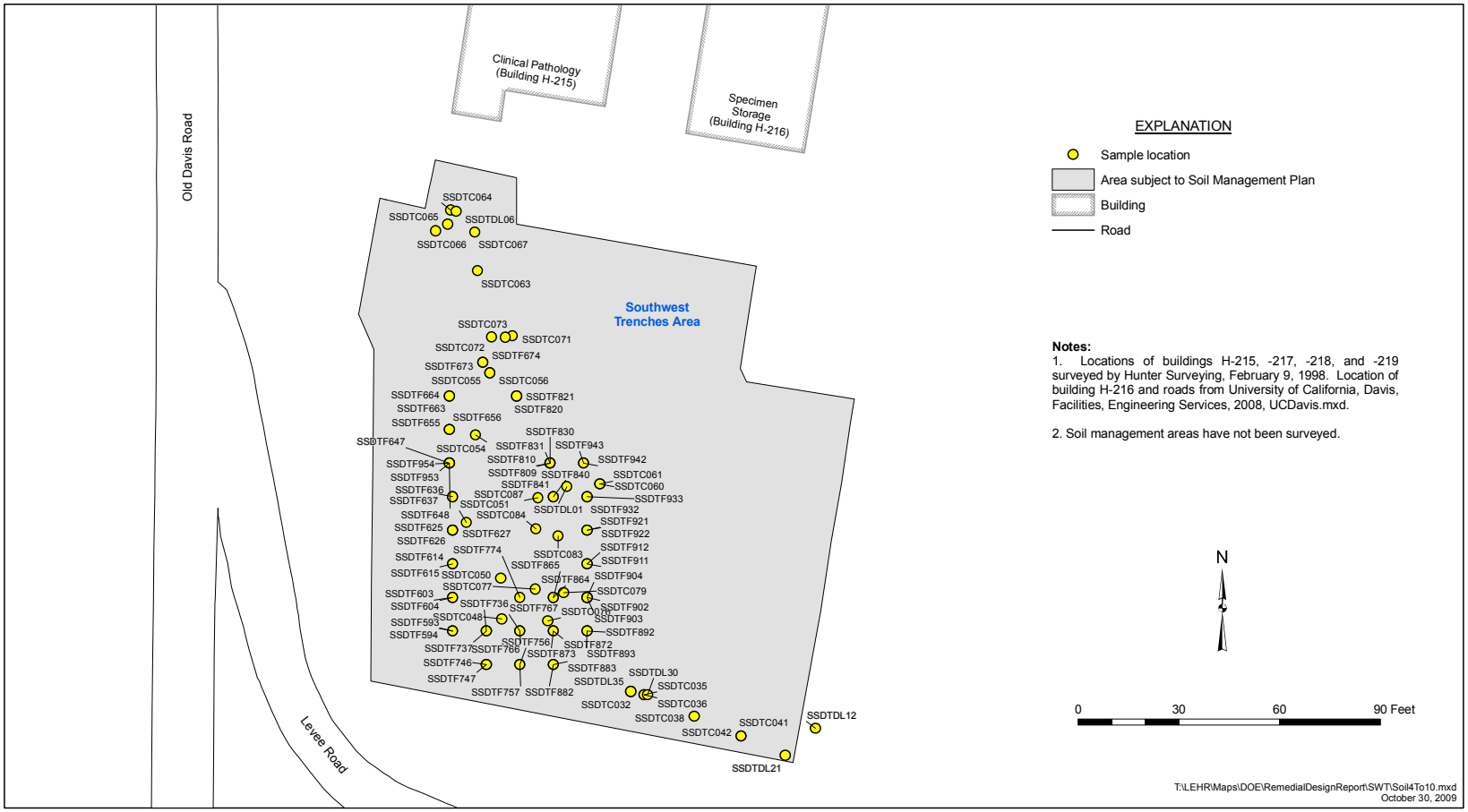
Attachment B Figure 10. Soil Sample Locations for the Radium/Strontium Treatment Systems Area (>4 to 10 Feet Below Ground Surface)



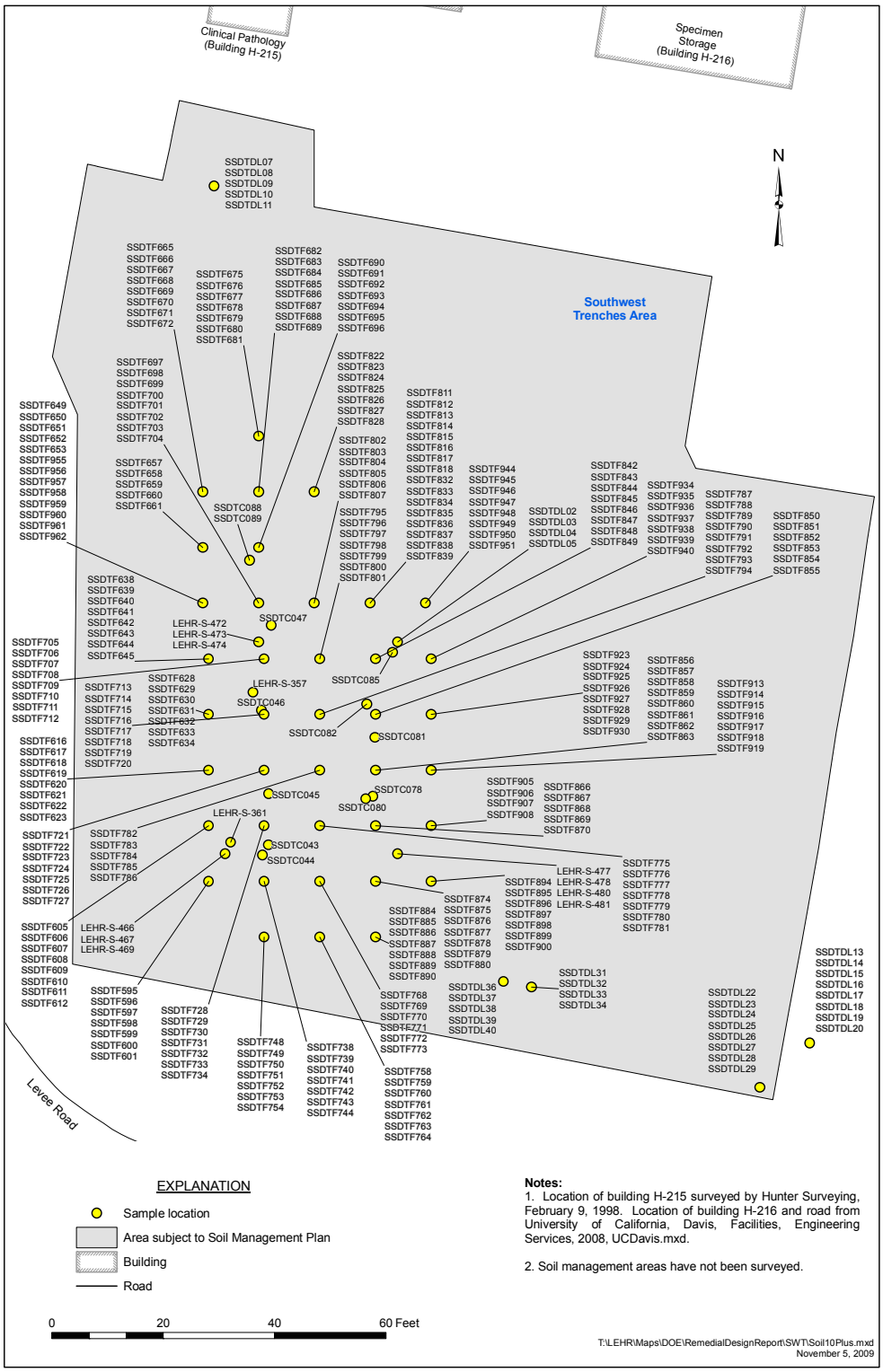
Attachment B Figure 11. Soil Sample Locations for the Radium/Strontium Treatment Systems Area (>10 to 47.5 Feet Below Ground Surface)



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

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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 is 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 and 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.

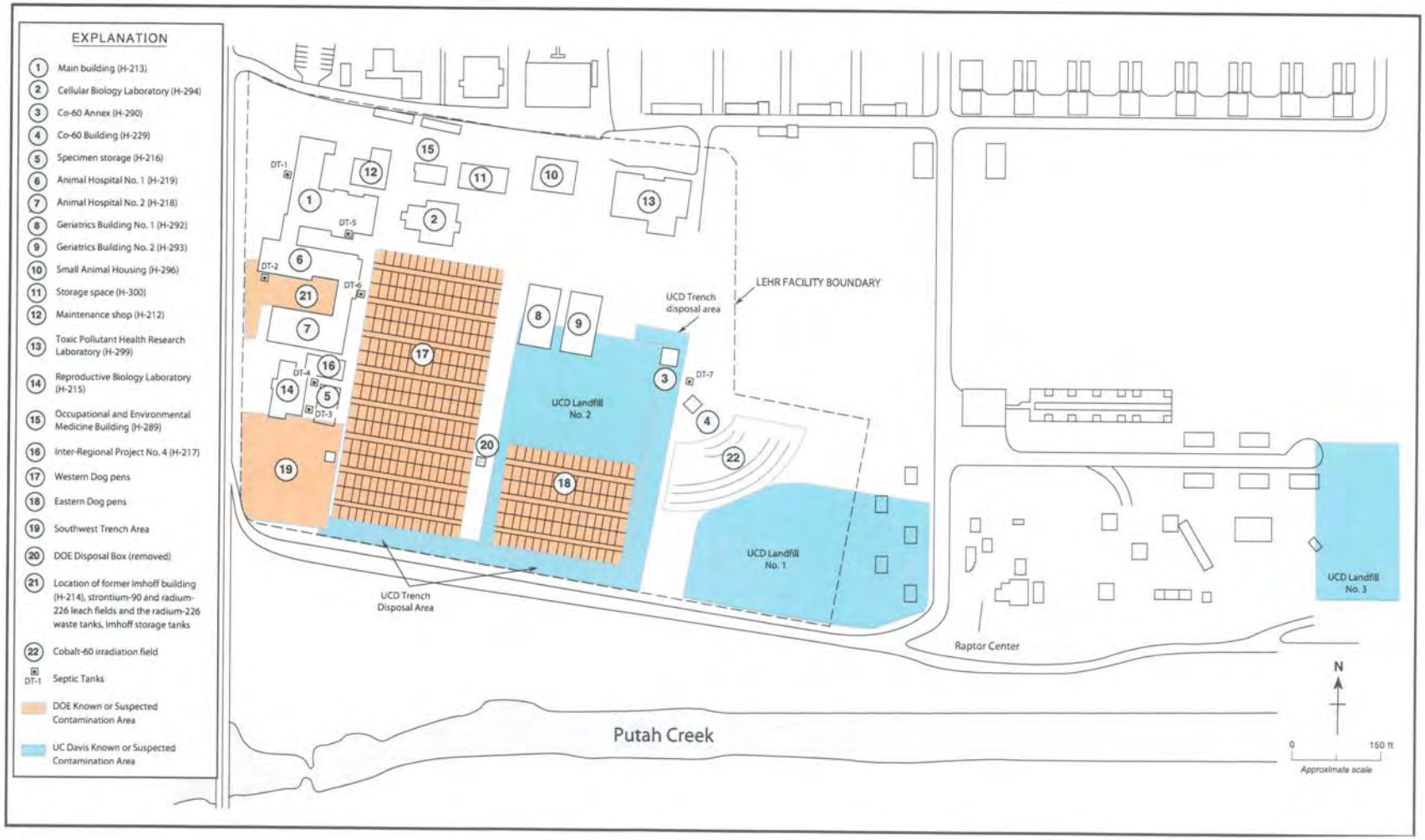

Figure 1. LEHR Facility/Old Campus Landfill, UC Davis, California

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.

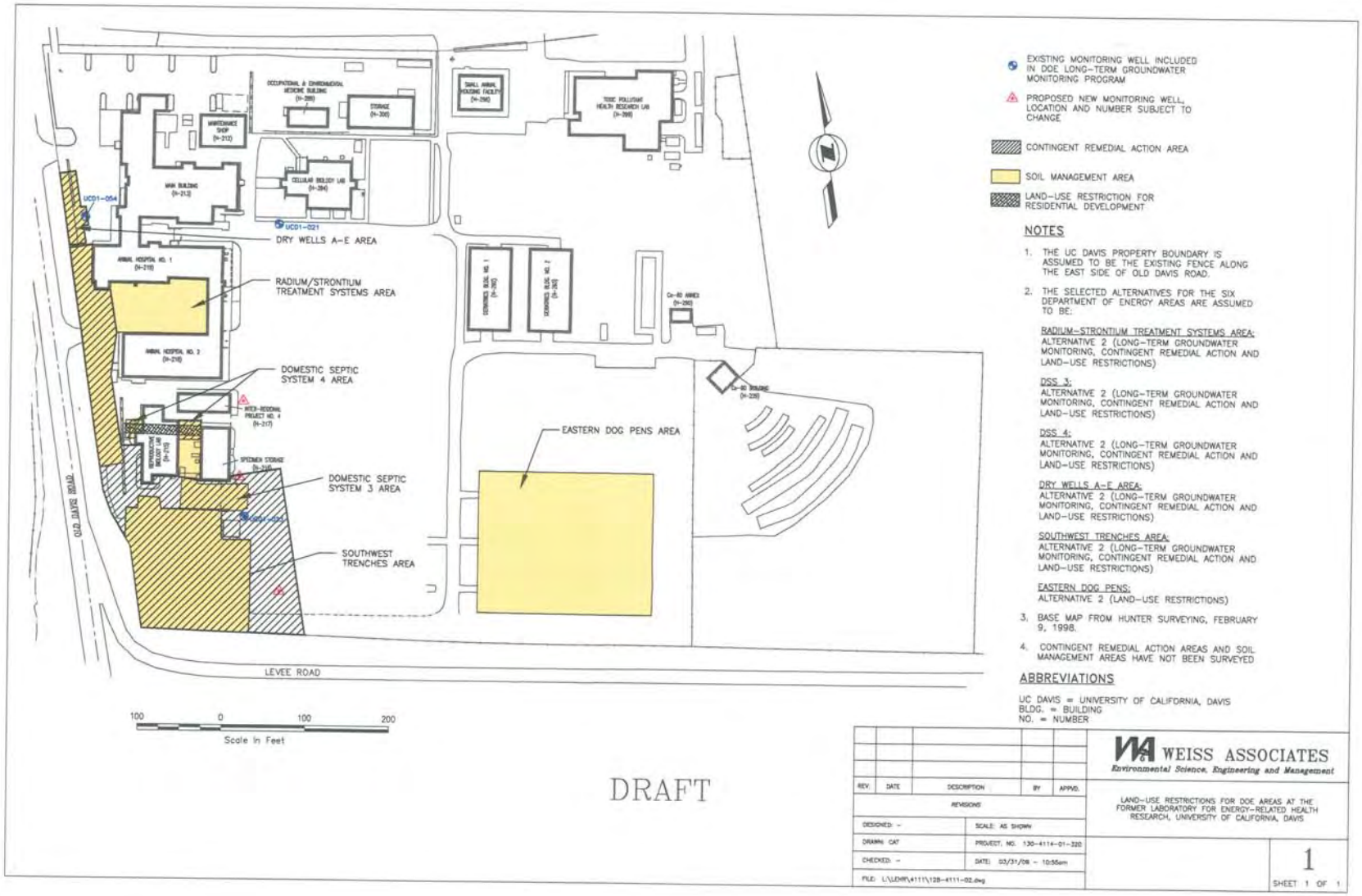

Figure 2. Land Use Restrictions for DOE Areas at the Former Laboratory for Energy-Related Health Research, UC Davis, California

(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. Covenants Not to Sue for Future Costs

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. Exceptions to the Covenants Not to Sue

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

Sample Collection Procedures

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Sample Collection Procedures

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
- Chain-of-custody forms

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

- **Specific conductance, oxidation-reduction potential, dissolved oxygen, 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 C-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 C-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	
Copper				1 µg/L	
Iron				50 µg/L	
Manganese				1 µg/L	
Molybdenum				1 µg/L	
Nickel				1 µg/L	
Selenium				1 µg/L	
Silver				1 µg/L	
Zinc				5 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	Filter[i], nitric acid, pH<2	1 pCi/L	180 days
Gross Beta	EPA 900.0	1-liter polyethylene plastic	Filter[i], nitric acid, pH<2	2 pCi/L	180 days
Cesium-137	EPA Method 901.1[d]	1-liter polyethylene plastic	Filter[i], nitric acid, pH<2	5 pCi/L	180 days
Potassium-40	EPA Method 901.1[d]	1-liter polyethylene plastic	Filter[i], nitric acid, pH<2	50 pCi/L	180 days
Strontium-90	EPA Method 905.0[e]	2-liter polyethylene plastic	Filter[i], nitric acid, pH<2	1 pCi/L	180 days
Carbon-14	EPA EERF C-01[f]	1-liter polyethylene plastic	None	7 pCi/L	180 days
Radium-226	EPA Method 903.1[g]	1-liter polyethylene plastic	Filter[i], nitric acid, pH<2	1 pCi/L	180 days
Uranium-238	EML HASL 300[c]	1-liter polyethylene plastic	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	0.1 mg/L	48 hours
Formaldehyde	SW-846, Method 8315[b]	1-liter amber glass	4 °C	50 µg/L	72 hours
Organics					
1,1-Dichloroethane	SW-846, Method 8260b	3 each 40 ml VOA, glass	hydrochloric acid, pH<2, 4 °C	0.5 µg/L	14 days
Benzene				0.5 µg/L	
Chloroform				0.5 µg/L	
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
Dieldrin				0.1 µg/L	

Notes:

[a] As shown, reporting limits are at or below maximum contaminant levels for all constituents except chlordane and below 2011 background levels for all inorganics except americium-241, cesium-137, and strontium-90. Reporting limits are above 2011 background levels for mercury, gross beta, uranium-238, and formaldehyde because 2011 background levels for these constituents are based on trace detections below the reporting limit.

[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).

Table C-1 (continued). Analytical Parameters for Groundwater Samples

[f] EPA, Eastern Environmental Radiation Facility.
[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.

Abbreviations:
EERF = Eastern Environmental Radiation Facility
EPA = U.S. Environmental Protection Agency
µg/L = micrograms per liter
mg/L = milligrams per liter
pCi/L = picocuries per liter

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

- The chain-of-custody
- The field logbook
- Sample numbers
- Sample labels
- 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
- 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
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
- 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
- The date and time the sample was collected

2.3 Data Validation and Compilation

The analytical laboratories are contracted to deliver detailed analytical reports, 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 2012) 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.