Proposed Plan

for the

University of California, Davis Area, Soil/Solid Waste and Soil Gas at the Laboratory for Energy-related Health Research/Old Campus Landfill Superfund Site, University of California, Davis, California

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Introduction

The United States Environmental Protection Agency (EPA) is issuing this **Proposed Plan** for the Laboratory for Energy-related Health Research/Old Campus Landfill Superfund Site located at the University of California, Davis (LEHR/OCL Site or Site). The EPA is requesting public comment on its **preferred remedial alternative** (Preferred Alternative) for this **National Priorities List** site to address areas with soil, **solid waste**, and **soil gas** contamination that may present unacceptable **risks** to human health and the environment. This Proposed Plan summarizes the history and extent of contamination, the cleanup process, and cleanup options under consideration. The need for groundwater cleanup will be addressed in a future Proposed Plan. (Words in bold are defined in the glossary).

The community is invited to ask questions about the Proposed Plan and to learn more at a **public meeting on February 10, 2015 from 6:00 pm to 8:30 pm in Room 130 Hoagland Hall on the UC Davis Campus**. Information about the public comment period and the public meeting are shown below. The EPA invites you to review and comment on the Proposed Plan during this period, and also invites you to review material, ask questions, and participate in making a final decision about the Preferred Alternative during the public meeting. EPA, in consultation with the other Regulatory Agencies, may modify the Preferred Alternative in response to public comments or new information. Therefore, you are encouraged to review and comment on this Proposed Plan.

How You Can Be Involved

Public Comment Period

☐ **January28, 2015 to February 26, 2015.**

Mail written comments postmarked no later February 26, 2015 to:

David Stensby
Remedial Project Manager
U.S. Environmental Protection Agency
75 Hawthorne Street SFD-7-1
San Francisco, CA 94105

Public Meeting

☐ **February 10, 2015 at 6:00 p.m. – 8:30 p.m.**

Room 130 - Hoagland Hall
University of California Davis

During the public meeting, EPA will present Proposed Plan and record comments. A final cleanup decision will not be made until all comments are considered.

Directions and Parking Permit information for the public meeting on February 10, 2015 are as follows: from 1-80 West, exit north on State Highway 113, exit Hutchison Drive bearing right (pass three traffic signals), turn left on Kleiber Hall Drive and left into the second parking lot (#27). Park in a "regular" space and obtain a parking permit from room 130 in Hoagland Hall to be placed on the dash of your car.

EPA will not make a final decision, set forth in a **Record of Decision** (ROD), about which remedial alternative to select until it considers all comments. The ROD will include a Responsiveness Summary to explain EPA's response to each comment received during the public comment period.

The LEHR/OCL Site is located in Solano County, south of the city of Davis, California (Please refer to Figure 1 for a map showing the site location). The Site areas subject to this Proposed Plan include the following, defined as land disposal units: the Eastern Trenches, Landfill Unit 1 (LFU-1), LFU-2, LFU-3, Southern Trenches, the Hopland Field Station Disposal Area (HFSDA on Figure 2), and the Waste Burial Holes as shown on Figure 2. As the lead agency for the Site, the EPA prepared this Proposed Plan in consultation with the California Department of Toxic Substances Control and the Central Valley Regional Water Quality Control Board (Water Board).

Consistent with the requirements of the **Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA) and Section 300.430(f)(2) of the **National Oil and Hazardous Substances Pollution Contingency Plan** (NCP), this Proposed Plan explains EPA's Preferred Alternative and how it will reduce risks to the community.

EPA's Preferred Alternative is Alternative Solid Waste (SW)-6 from the Final **Feasibility Study**, which includes **Volatile Organic Compound** (VOC) "**Hot Spot**" Removal, Construction of Three On-Site **Corrective Action Management Units** (CAMUs) with Multiple-Layer Caps, **Institutional Controls**, Drainage Controls, and Groundwater Monitoring. Alternative SW-6 has been modified since it was originally presented in the Final Feasibility Study for the University of California, Davis Areas, Volume 1: Soil/Solid Waste and Soil Gas, Laboratory for Energy-related Health Research/Old Campus Landfill Superfund Site, University of California, Davis, dated April 30, 2012 (FS Report). In the FS Report, Alternative SW-6 included the excavation and disposal of known **Principal Threat Waste** (PTW) and solid waste excavated from the Eastern Trenches and a portion of LFU-3 underlying the concrete-lined drainage channel. The PTW would be sent off-site for disposal while the solid waste would be placed within a nearby CAMU. The modified Alternative SW-6 proposes leaving soil and solid waste largely undisturbed and protected under landfill caps with the exception of the two VOC "hot spot" areas. Excavation of the two VOC "hot spot" areas will protect groundwater from further contamination by VOCs and minimize the potential for **vapor intrusion** into buildings. As a result of this modification, Alternative SW-6 minimizes excavation, segregation, and characterization of PTW for disposal at licensed off-site facilities; this approach is consistent with the **presumptive remedy** for landfills, since the location of all of the PTW within the landfills is unknown.

This Proposed Plan summarizes information detailed in the Final Remedial Investigation Report LEHR/SCDS Environmental Restoration, University of California, Davis, dated December 29, 2004 [**Remedial Investigation** (RI) Report]; the FS Report; and other documents contained in the **Administrative Record** file for the Site. The EPA encourages the public to review these documents to gain an understanding of the environmental investigation activities and risk assessments that have been conducted at the Site. The documents are available for public review at the locations listed on page 17. Additionally, information about the public meeting for this

Proposed Plan and opportunities to submit your comments during a 30-day public comment period are available on pages 1 and 17.

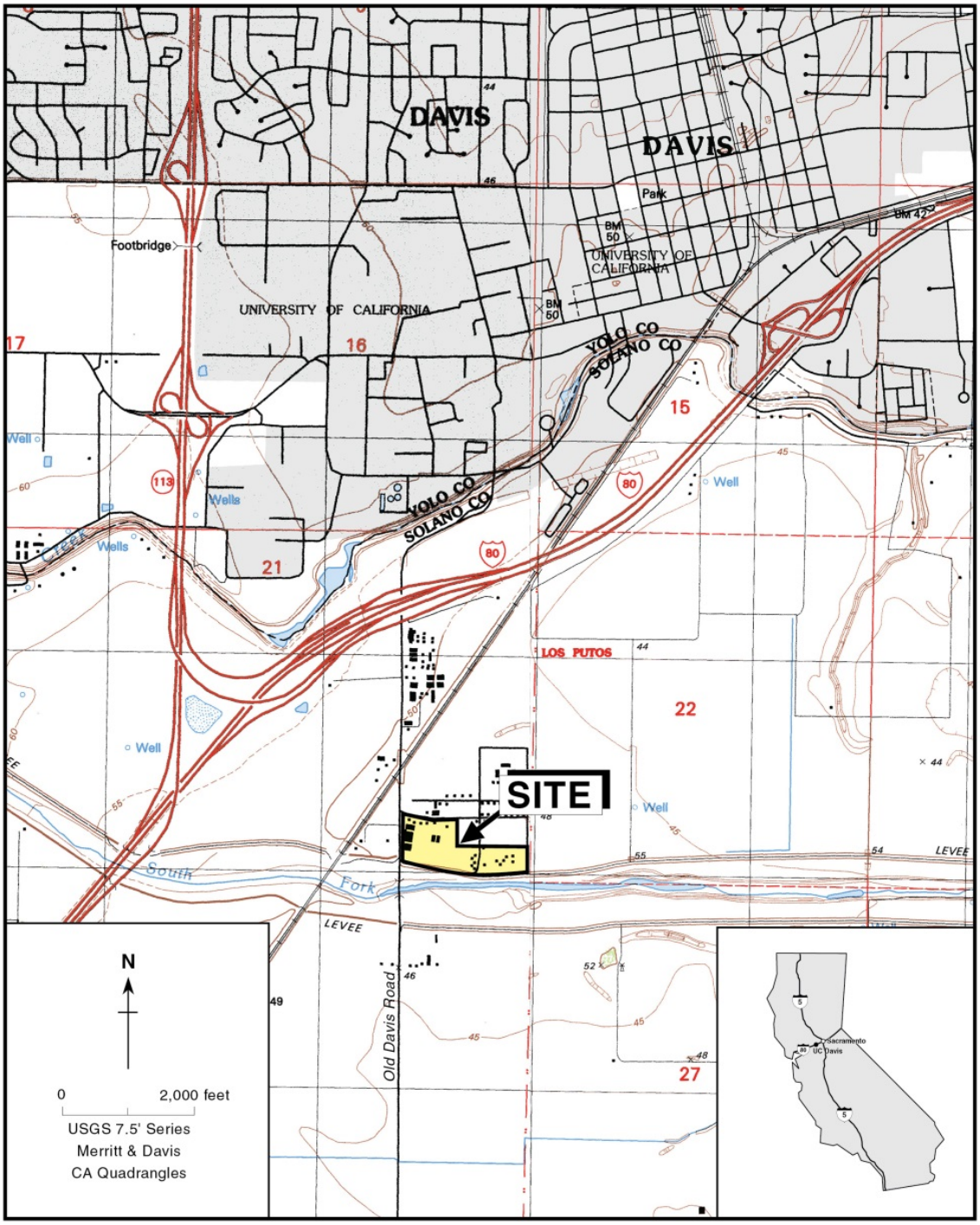

Figure 1. Site Vicinity Map - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Adapted from Weiss Associates, 2012, Final Feasibility Study for the University of California, Davis Areas Volume 1: Soil, Solid Waste, and Soil Gas, April 30. 7/16/13

Figure 1: Site Location

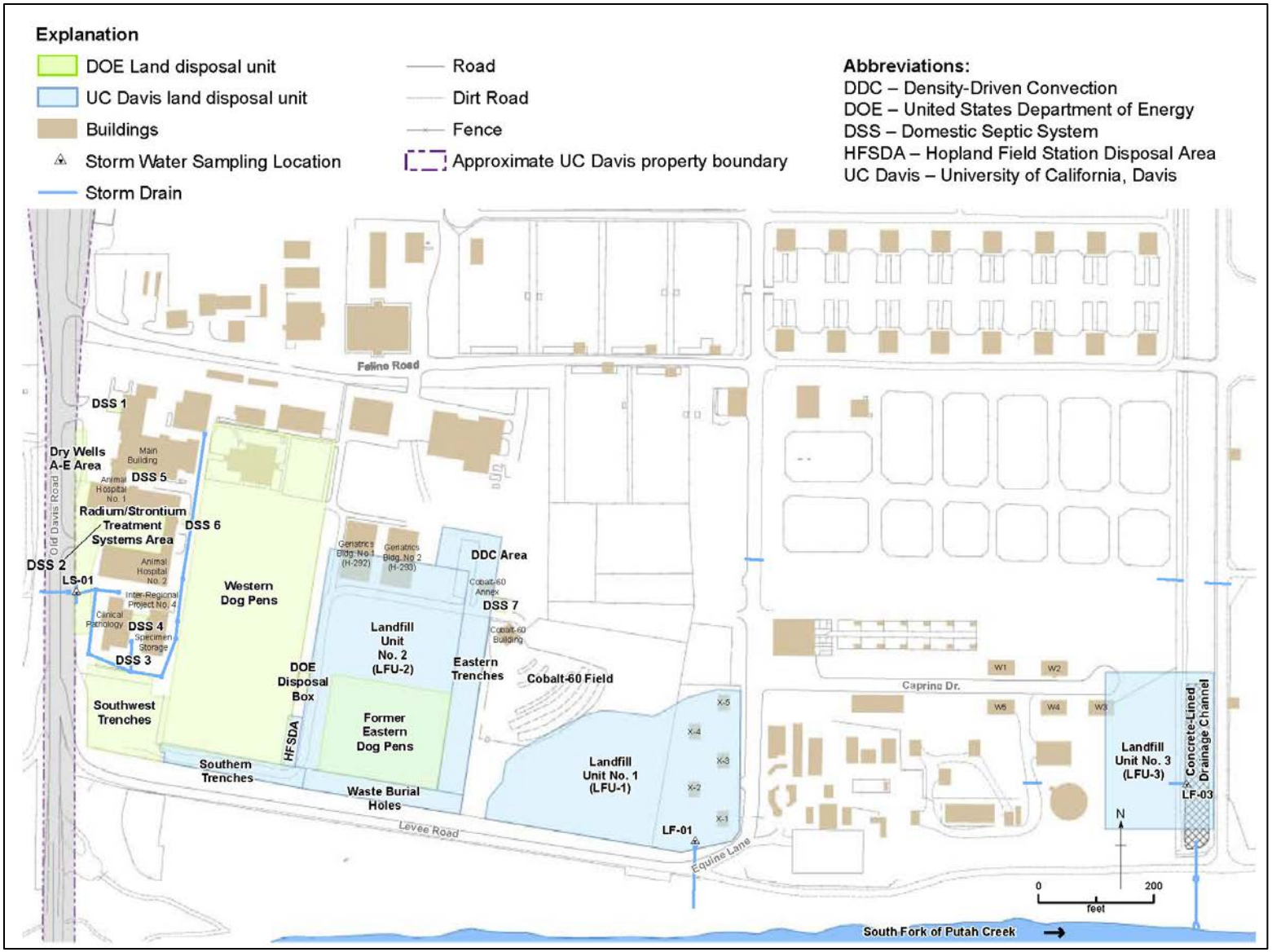

Figure 2: LEHR/OCL Site - Landfill (solid waste) areas in light blue.

Site Background

The LEHR/OCL Site covers approximately 25 acres. It contains laboratory buildings and undeveloped land owned and maintained by the Regents of the University of California. UC Davis operated three land disposal units (LFU-1, LFU-2, and LFU-3) that received municipal-type waste from the main campus between the early 1940s and 1967. The Waste Burial Holes and Eastern Trenches areas received chemical, laboratory, and radioactive wastes from the UC Davis campus until 1974 and 1965, respectively. The Southern Trenches area received minor amounts of experimental wastes from the UC Davis laboratories. Between 1968 and 1970, the Eastern Dog Pens were constructed on top of the southern portion of LFU-2. These dog pens were used to house research beagles until 1988, when research ceased.

Characterization investigations began at the LEHR/OCL Site in 1984 and have been ongoing. Studies began with an Initial Assessment Survey in 1984. The most recent investigation to evaluate data gaps was conducted in 2009 to study chromium contamination in **groundwater**. General groundwater and soil gas impacts from the UC Davis landfills were also investigated, as LFU-1, LFU-2, and LFU-3 are a source of groundwater contamination.

In 2011, the EPA issued a fact sheet to inform the public about progress at the site and interviewed community members for an update of the Community Involvement Plan.

Site Description

The LEHR/OCL Site is relatively flat and is part of the UC Davis South Campus. The South Fork of Putah Creek is located about 250 feet south of the site and is separated from the site by a levee. The site is located in a historic floodplain. Groundwater in the area is present in what are considered to be four separate geologic layers or **hydrostratigraphic units**. In the upper hydrostratigraphic unit, groundwater depths typically fluctuate between 20 and 40 feet below ground surface, depending on the season. The wastes in the landfills within the LEHR/OCL Site do not extend into groundwater, but groundwater sampling indicates that some chemicals released from the landfills have reached groundwater. Computer modeling indicates that other contaminants released from the landfills into soil may reach groundwater.

Material constituting potential PTW was found during exploratory trenching at the LEHR/OCL Site by UC Davis. PTW is waste that is considered highly toxic, highly mobile, or potentially presents a risk to human health or the environment in the event of exposure. The locations and types of PTW at the LEHR/OCL Site are unknown but may be ubiquitous throughout the land disposal units.

In 1999, UC Davis initiated a removal action at the Waste Burial Holes, excavating solid wastes from soil and disposing of them at an off-site landfill; excavated soil was returned to the excavations. In 1997, UC Davis began a groundwater extraction interim removal action from the second hydrostratigraphic unit to remove VOCs. This system is located downgradient of LFU-1 and LFU-2 and is still operating. A pilot test to remove VOCs from upper hydrostratigraphic unit groundwater in the chloroform source area in the northern LFU-2 area was initiated in 2000;

this system was expanded and is still operating to remove chloroform from the source area to minimize contaminant migration.

Scope and Role of Response Action

Landfill contents are non-uniform in nature. This, along with the volume of material typically found in the landfills, makes them difficult to characterize. Given that some of the contaminants detected in the groundwater contaminant plumes at the LEHR/OCL Site were not detected during previous soil characterization efforts, it can be concluded that these previous soil characterization efforts did not fully characterize the land disposal units. Since it is difficult to locate contaminants and contaminant sources without extensive characterization, and PTW and hot spots are known to exist within the land disposal units, the risk assessments likely underestimate the risk. This uncertainty makes it difficult to assess remedial technologies, especially ones that involve treatment.

EPA has identified containment as the most likely response action at landfill sites that contain primarily municipal and, to a lesser extent, hazardous wastes. Therefore, containment is considered the presumptive remedy for landfills. It should be noted that under the presumptive remedy, further characterization is not required, maximum concentrations will remain unknown, and a more comprehensive risk assessment is not necessary. However, the presumptive remedy will prevent direct contact with landfill contents and potentially unknown risks and hazards, minimize infiltration and resulting contaminant leaching to groundwater, and control surface water runoff and erosion.

The overall cleanup strategy at the LEHR/OCL Site is to address the risk to human health and the environment from solid waste and contaminated soil through excavation and containment. The western portion of the Site was addressed by the Department of Energy pursuant to a Record of Decision signed in 2009. Groundwater contamination will be addressed in a future proposed plan.

Some of the remedial alternatives that were evaluated in the FS Report involve excavation and **ex situ treatment** of PTW for off-site disposal. The majority of the proposed remedial alternatives at the LEHR/OCL Site also include containment of most wastes and contaminated soil under one to three landfill caps.

Site Risks

In 2004 and 2006, the University of California, Davis completed two **risk assessments**, one to evaluate the risk to human health and the other to evaluate the risk to **ecological receptors** from exposure to contaminated soil, solid waste, and soil gas. The findings of these risk assessments are summarized in the FS Report, which is available at the Information Repositories listed on page 17 of this Proposed Plan.

The **human health risk assessment** considered the various ways that humans might be exposed to chemicals, the possible concentrations of chemicals that could be encountered during exposure, and the potential frequency and duration of exposure (referred to as **exposure**

scenarios). These exposure scenarios are based on the reasonably anticipated future use of the land and consider the most sensitive individual for that anticipated future use. Although UC Davis plans to continue using the LEHR/OCL Site as a research facility for the foreseeable future, the human health risk assessment nevertheless conservatively assumed a hypothetical on-site resident (residential receptor).

Human health risk is classified as cancer risk (from exposure to carcinogens) or noncancer hazard (from exposure to non-carcinogens). Cancer risk is an estimated probability that a person will develop cancer from continuous exposure (24-hours per day) to specific concentrations of site contaminants over a 70-year lifetime. To be conservative in evaluating cancer risks, LEHR/OCL Site areas with a potential risk that exceeded a probability of 1 in 1,000,000 were evaluated. This value represents the lower end of the **risk management range** of 1 in 10,000 (expressed as 1x10-4) to 1 in 1,000,000 (expressed as 1x10-6). A probability of 1 in 1,000,000 is the risk that for every 1,000,000 people, one additional cancer case may occur as a result of exposure to site contaminants.

Noncancer hazard is the potential for experiencing adverse health effects other than cancer, and is expressed numerically in terms of the **hazard index**. A cumulative hazard index of 1 or less that takes into account each constituent included in the risk assessment is considered an acceptable exposure level for noncancer health hazards. To be conservative in assessing non-cancer health risks, areas at the LEHR/OCL Site with a hazard index greater than 1 were evaluated in the FS Report.

Remedial actions are proposed at LEHR/OCL Site areas where the cancer risks from exposure to contaminated soil and waste are greater than 1 in 1,000,000 and noncancer hazard indexes are greater than 1. **Preliminary Remediation Goals** based on the risk to human health were developed to protect the community from exposure to chemicals that pose unacceptable risks. Human exposure to chemical concentrations exceeding these preliminary remediation goals will be addressed by the remedial actions.

Table 1 (page 23) provides the major **Constituents of Concern**, estimated cancer and non-cancer risks associated with the **exposure pathways** for constituents of concern, and associated preliminary remediation goals. Table 2 (pages 24 and 25) provides the total cancer and non-cancer risks to human health based on findings from the 2006 risk assessment.
A **screening-level ecological risk assessment** was performed and included the evaluation of risks to receptors such as plants, small mammals, and birds. Based on this risk assessment, ecological risks were found to be acceptable for the Eastern Trenches and Southern Trenches and no further evaluation of ecological receptors was recommended. Ecological risk was found to be ***de minimus*** at the Waste Burial Holes (with the possible exception of the special-status California horned lark). However, no further evaluation was recommended from an ecological perspective. The human health preliminary remediation goals and the presumptive remedy are intended to be protective of all ecological receptors.

It is EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public

health or welfare or the environment from the risks associated with actual or threatened releases of hazardous substances to the environment.

Remedial Action Objectives

The **Remedial Action Objectives** (RAOs) describe the goals of the proposed cleanup. They were developed to assist in identifying and evaluating remedial alternatives to address risks to human health and the environment at the LEHR/OCL Site. The RAOs are:

- To prevent human contact with contamination in soil, solid waste, and soil gas that may pose excess cumulative cancer risk greater than the lower end (1x10-6) of the risk management range of 1x10-4 to 1x10-6.
- To prevent human contact with contamination in soil, solid waste, and soil gas that may pose a non-cancer hazard with a hazard index greater than 1.0.
- To prevent potential future impacts to groundwater from solid waste, contaminated soil, or soil gas, which may leach, contaminate groundwater, and cause exceedances of the **Maximum Contaminant Levels**.
- To minimize threats to the environment by limiting ecological receptor exposure, including, but not limited to, sensitive and critical habitats of species protected under the state and federal Endangered Species Acts.
- To prevent contact of surface water or storm water with landfill waste or contaminated soil.

To attain RAOs, site-specific preliminary remediation goals for soil are developed for protection of human health and groundwater resources. Exposure to soil, solid waste, or soil gas with chemical concentrations exceeding the preliminary remediation goals could pose an unacceptable risk that would be addressed by the remedial action. It should be noted that the more conservative point of departure (i.e., lower end [1x10-6] of the risk management range of 1x10-4 to 1x10-6) was utilized due to the use of the presumptive remedy and the fact that landfills cannot be fully characterized. Similarly, the site-specific preliminary remediation goals for soil are based on the most conservative (the lowest) of human health regional screening levels for unrestricted land use or groundwater impact designated levels, as presented in Table 1. The site-specific preliminary remediation goals will be finalized in the ROD.

Summary of Remedial Alternatives

Ten alternatives were developed for consideration in addressing contamination at the LEHR/OCL Site. The remedial alternatives ranged from no action to the complete removal of contaminated soil and waste from the LEHR/OCL Site. Three of the alternatives do not achieve the RAOs. The remaining alternatives, which are summarized below, present a variety of approaches, with different costs, meet the RAOs with varying degrees of protectiveness.

Institutional controls and groundwater monitoring are common elements of all alternatives except Alternative SW-1. Institutional controls would, as appropriate: 1) allow access to monitoring wells; 2) restrict drilling (or other subsurface penetration) and access to groundwater; 3) protect landfill caps and/or restrict surface changes affecting drainage, infiltration, and

potential constituents of concern mobilization; and, 4) require assessment and mitigation of potential vapor intrusion hazards to buildings. Land-use restrictions would consist of implementing a codified land use restriction in coordination with the UC Davis Office of the President, Real Estate Services Group, and the UC Davis Office of Administrative and Resource Management. A land use covenant would be recorded with Solano County that prohibits residential land use and restricts non-residential use of the land disposal units. Signage would be posted to notify workers of potential subsurface hazards both during remedial action phases and post-construction activities while institutional controls remain in place. Subsurface hazard notification would consist of metal signs on posts.

Groundwater samples would be collected from designated monitoring wells located downgradient of the excavated/capped areas to evaluate the effectiveness of the remedial alternative. Quarterly sampling would be conducted during the first year and annual sampling would be completed for subsequent years. Monitoring results would be reported in the UC Davis annual groundwater monitoring reports and evaluated in five-year reviews.

For all alternatives except Alternatives SW-1 and SW-2, ex situ treatment (e.g., soil solidification/stabilization) of a fraction of the excavated material may be necessary to render the materials non-hazardous prior to off-site disposal.

Components and elements included in Alternatives SW-1 through SW-10 are presented in Table 3 (pages 26 and 27).

Alternative SW-1 - No Action/No Further Action
This alternative consists of conducting no further cleanup. CERCLA requires an evaluation of a no action alternative to provide a baseline for comparison with other remedial alternatives.

Alternative SW-2 - Institutional Controls and Groundwater Monitoring
This alternative leaves soil and waste, and soil gas undisturbed, but requires the implementation of institutional controls and groundwater monitoring.

Alternative SW-3 - VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units (CAMUs) with Graded Covers, Institutional Controls, Drainage Controls, and Groundwater Monitoring
This alternative includes excavation and off-site disposal of known PTW and two soil gas VOC "hot spot" areas, but leaves most soil and waste in on-site CAMUs where the existing soil cover would be graded to enhance drainage. The existing storm water drainage system would also be expanded and excavations would be backfilled with clean soil. This alternative includes institutional controls and groundwater monitoring. One building [i.e., Cobalt-60 Annex (H-290)] would be removed to allow for excavation, construction, and proper grading of the adjacent CAMU. Non-recycled building waste and waste excavated for drainage controls would be placed beneath the cap of the adjacent CAMU.

Alternative SW-4 – VOC "Hot Spot" Removal, Three On-Site CAMUs with Evapotranspiration Covers, Institutional Controls, Drainage Controls, and Groundwater Monitoring

This alternative involves the excavation and off-site disposal of known PTW, two VOC "hot spot" areas, and a portion of LFU-3 underlying the concrete-lined drainage channel. Excavations would be backfilled with clean soil and the CAMUs would be covered with **evapotranspiration covers.** The existing storm water drainage system would be expanded. It includes institutional controls and groundwater monitoring. Nine buildings [i.e., Cobalt-60 Annex (H-290), Geriatrics Bldg. No. 1 (H-292), Geriatrics Bldg. No. 2 (H-293), X-1, X-2, X-3, X-4, X5, and W3] would be removed to allow excavation, construction, and proper grading of the three on-site CAMUs. Non-recycled building waste and waste excavated for drainage controls would be placed beneath the cap of the adjacent CAMU.

Alternative SW-5 - VOC "Hot Spot" Removal, Three On-Site CAMUs with Asphalt Covers, Institutional Controls, Drainage Controls, and Groundwater Monitoring

This alternative includes excavation and off-site disposal of known PTW, two VOC "hot spot" areas, and a portion of LFU-3 underlying the concrete-lined drainage channel. Excavations would be backfilled with clean soil and the CAMUs would be covered with high density polyethylene lined asphalt pavement caps and the existing storm water drainage system would be expanded. It includes institutional controls and groundwater monitoring. Nine buildings [i.e., Cobalt-60 Annex (H-290), Geriatrics Bldg. No. 1 (H-292), Geriatrics Bldg. No. 2 (H-293), X-1, X-2, X-3, X-4, X5, and W3] would be removed to allow excavation, construction, and proper grading of the three on-site CAMUs. Non-recycled building waste and waste excavated for drainage controls would be placed beneath the cap of the adjacent CAMU.

Alternative SW-6 - VOC "Hot Spot" Removal, Three On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring

This alternative has been modified since it was originally presented in the FS Report to align it more closely with the presumptive remedy for landfills. The alternative leaves soil and waste largely undisturbed, but includes excavation and off-site disposal of the two VOC "hot spot" areas. Excavations would be backfilled with clean soil and the CAMUs would be covered with multiple-layer caps and the existing storm water drainage system would be expanded. Each multiple-layer cap will consist of a foundation layer, a low-permeability synthetic liner, a compacted clay layer, a drainage layer, a bio-protection layer, and an upper soil layer to reduce infiltration and leaching of contaminants to groundwater. This alternative includes institutional controls and groundwater monitoring. Nine buildings [i.e., Cobalt-60 Annex (H-290), Geriatrics Bldg. No. 1 (H-292), Geriatrics Bldg. No. 2 (H-293), X-1, X-2, X-3, X-4, X5, and W3] would be removed to allow excavation, construction, and proper grading of the three on-site CAMUs. Non-recycled building waste and waste excavated for drainage controls would be placed beneath the cap of the adjacent CAMU.

Alternative SW-7 - VOC "Hot Spot" Removal, Two On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring

This alternative includes excavation and offsite disposal of known PTW and two VOC "hot spot" areas, consolidating soil and waste (located at LFU-3) into two on-site CAMUs (located at LFU-1 and LFU-2/Waste Burial Holes/Eastern Trenches), backfilling the excavations with clean soil,

covering the CAMUs with multiple-layer caps to reduce infiltration and leaching of contaminants to groundwater, expanding the existing storm water drainage system, implementing institutional controls, and groundwater monitoring. Nine buildings [i.e., Cobalt-60 Annex (H-290), Geriatrics Bldg. No. 1 (H-292), Geriatrics Bldg. No. 2 (H-293), X-1, X-2, X-3, X-4, X5, and W3] would be removed to allow excavation, construction, and proper grading of the two on-site CAMUs. Non-recycled building waste and waste excavated for drainage controls would be placed beneath the cap of the adjacent CAMU.

Alternative SW-8 - VOC "Hot Spot" Removal, One On-Site CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Controls, and Groundwater Monitoring
This alternative includes excavation and offsite disposal of known PTW and two VOC "hot spot" areas, consolidating soil and waste (located at LFU-3) into a single on-site lined CAMU that overlaps portions of LFU-1 and LFU-2/Waste Burial Holes/Eastern Trenches, backfilling the excavations with clean soil, covering the CAMU with a multiple-layer cap to reduce infiltration and leaching of contaminants to groundwater, expanding the existing storm water system, implementing institutional controls, and groundwater monitoring. The single CAMU, covering approximately 6.7 acres, would have a multiple-layer cap, bottom liner, and a **leachate** collection and removal system. Nine buildings [i.e., Cobalt-60 Annex (H-290), Geriatrics Bldg. No. 1 (H-292), Geriatrics Bldg. No. 2 (H-293), X-1, X-2, X-3, X-4, X5, and W3] would be removed to allow excavation, construction, and proper grading of the one on-site CAMU. Non-recycled building waste and waste excavated for drainage controls would be placed beneath the cap of the CAMU.

Alternative SW-9 - Excavate and Dispose of Waste Off-Site, Waste Burial Holes CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Controls, and Groundwater Monitoring
This alternative consists of excavating most soil and waste for off-site disposal. Soil and waste including PTW and soil from the VOC "hot spot" areas from LFU-1, LFU-2, LFU-3, and the Eastern Trenches, would be excavated, segregated, and characterized for transport to licensed off-site facilities. These excavated land disposal units would be backfilled with clean fill. The Waste Burial Holes and a section of LFU-2 bordering the Waste Burial Holes to the north would be designated as a CAMU and would receive a multiple-layer cap covering approximately 0.6 acres to reduce infiltration and leaching of contaminants to groundwater. The Southern Trenches and Hopland Field Station Disposal Area would be excavated and the material consolidated in the Waste Burial Holes CAMU after segregation of PTW for off-site disposal; these areas would be backfilled with clean fill. Nine buildings [i.e., Cobalt-60 Annex (H-290), Geriatrics Bldg. No. 1 (H-292), Geriatrics Bldg. No. 2 (H-293), X-1, X-2, X-3, X-4, X5, and W3] would be removed to allow excavation, construction of the Waste Burial Holes CAMU, and proper grading of the backfilled land disposal units and Waste Burial Holes CAMU.

Alternative SW-10 - Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Controls, and Groundwater Monitoring
All of the soil and waste from each of the land disposal units would be excavated, segregated, and characterized for transport to licensed off-site facilities. The excavated land disposal units would be backfilled with clean fill. Nine buildings [i.e., Cobalt-60 Annex (H-290), Geriatrics

Bldg. No. 1 (H-292), Geriatrics Bldg. No. 2 (H-293), X-1, X-2, X-3, X-4, X5, and W3] would be removed to allow excavation and proper grading of the backfilled land disposal units.

Table 4 on page 28 provides the estimated quantities of material to be excavated, estimated time to construct and implement the remedy until RAOs are met and the estimated costs, separated into capital (construction), annual operation and maintenance (O&M) and total present worth costs.

H. Evaluation of Alternatives

The remedial alternatives were evaluated using the criteria listed in the NCP. General descriptions of the nine criteria are presented in Figure 3.

Protection of human health and the environment and compliance with A**pplicable or Relevant and Appropriate Requirements** (ARARs) are threshold criteria that each alternative must meet to be eligible for selection, unless they are waived. A complete discussion of ARARs for all of the alternatives is presented in Appendix D of the FS Report.

The five balancing criteria (i.e., long-term effectiveness, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost) are used to weigh major tradeoffs in the benefits and limitations among alternatives. Modifying criteria include state acceptance and community acceptance.

Table 5 on page 29 summarizes the comparison of the remedial alternatives for the LEHR/OCL Site. The alternatives were compared using the NCP criteria (see Figure 3). A detailed comparison of the Alternatives can be found in the FS Report. The following is a summary of the comparisons that were made in the remedial alternative evaluations of the FS Report for the LEHR/OCL Site.

Criterion 1: Overall Protection of Human Health and the Environment

Alternative SW-1 does not meet the threshold requirement of overall protection of human health and the environment because contamination that poses an unacceptable risk to human receptors remains in place and the risk would not be reduced to an acceptable level through the implementation of institutional controls or other actions. Alternatives SW-2 through SW-10 provide varying levels of protection of human health and the environment depending on how soil and waste that poses an unacceptable risk would be managed to prevent contact with potential receptors or eliminated through excavation and disposal at a licensed disposal facility.

Criterion 2: Compliance with ARARs

Following the submittal of the FS Report, the regulatory agencies re-evaluated how the alternatives comply with ARARs. As a result of this re-evaluation, EPA determined that Alternatives SW-2 through SW-4 may not comply with state and federal ARARs due to the potential for constituents of concern remaining in place to migrate and contaminate groundwater. EPA determined that Alternatives SW-5 through SW-10 would comply with ARARs because

constituents of concern, remaining in place, are unlikely to migrate and contaminate groundwater. (Table 4 was updated from the similar table provided in the FS Report to reflect these modifications).

Criterion 3: Long-Term Effectiveness and Permanence

Alternatives SW-9 and SW-10 are more effective than Alternatives SW-2 through SW-8 in the long-term because the greatest volume of soil and waste would be removed providing additional land use options, fewer land use restrictions, and a lower potential for human exposure to residual contamination. The remedial actions associated with Alternatives SW-2 through SW-8 provide varying degrees of long term environmental protection and limit future land use options due to the requirement to maintain the covered/capped areas.

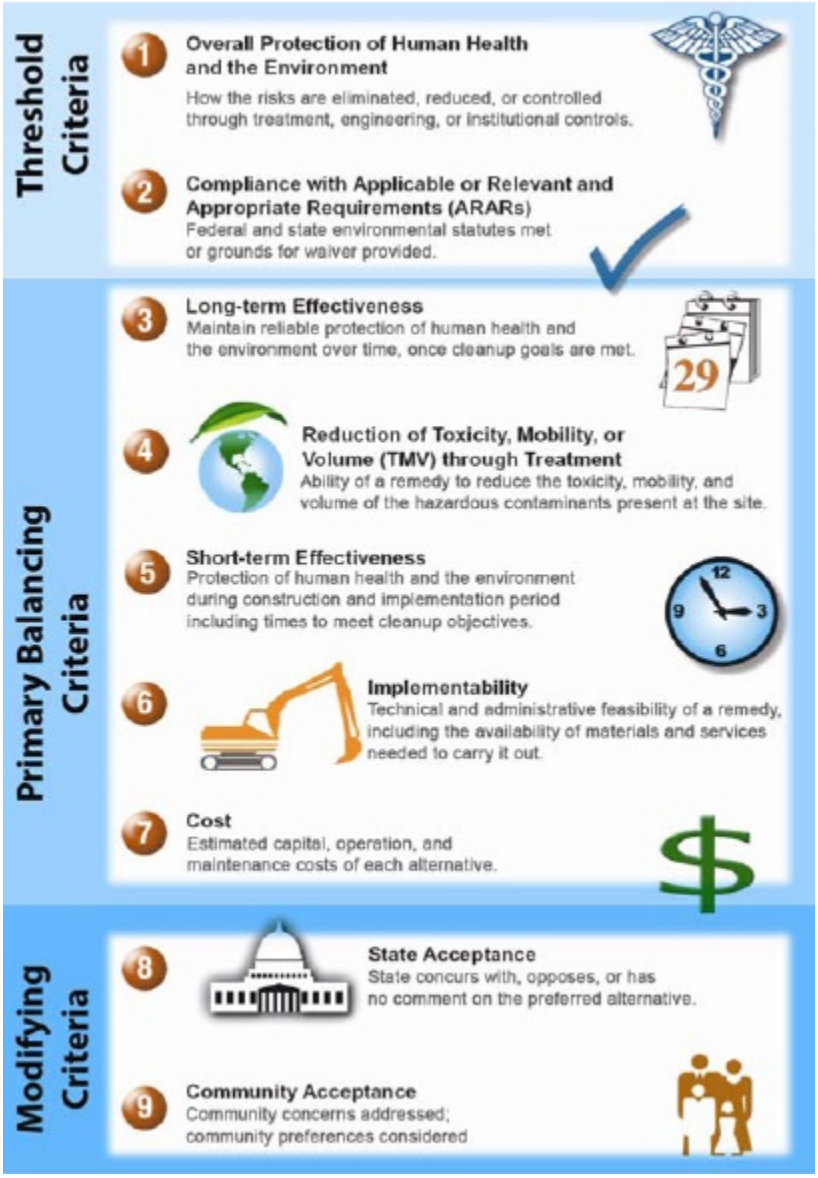

Figure 3: Criteria for Comparison of Alternatives

Criterion 4: Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

Alternative SW-2 does not include the use of treatment technologies. Alternatives SW-3 through SW-10 may include ex situ treatment (e.g., soil solidification/stabilization) of a fraction of the hazardous and mixed waste (hot spots) to render it non-hazardous prior to off-site disposal.

Criterion 5: Short-term Effectiveness

Alternative SW-2 would include minor short-term impacts during the installation of groundwater monitoring wells. Alternatives SW-3 through SW-10 would include site construction impacts, including localized noise and ground vibrations that would persist for several months during the excavation of PTW, the VOC "hot spot" areas, and contaminated soil and waste. The number of truck trips, total mileage, greenhouse gas/vehicle emissions, road dust, and total energy use increase from Alternative SW-3 to Alternative SW-10 due to the greater volume of waste sent off-site for disposal and increasing volume of imported fill and cap materials.

Criterion 6: Implementability

Alternative SW-2 is easily implemented. Alternatives SW-3 through SW-8 are more complex in that soil and waste would be excavated, segregated, and capped either under three graded covers (Alternative SW-3), three evapotranspiration covers (Alternative SW-4), three asphalt caps (Alternative SW-5), three multiple-layer caps (Alternative SW-6), two multiple-layer caps (Alternative SW-7), or one multiple-layer cap (Alternative SW-8). Alternative SW-9 includes excavation and a multiple-layer cap over the Waste Burial Hole CAMU, which is more complex to implement than Alternatives SW-3 through SW-8, and Alternative SW-10 which involves the excavation and off-Site disposal of each land disposal unit. The large-scale removal proposed in Alternative SW-10 would be relatively straightforward to implement because it includes the fewest design requirements.

Criterion 7: Cost

Alternative SW-2 has the lowest overall cost to complete ($6.5 million). The costs for Alternatives SW-3, -4, -5, -7, and -8 are directly related to the total volume of material excavated and sent for off-site disposal. The costs associated with Alternatives SW-4 through SW-7 only vary between $16.9 million to $21.1 million due to the similar volumes of soil and waste for off-site disposal. The costs associated with Alternative SW-3 are less than the costs associated with Alternatives SW-4 through SW-8 due to the lower costs associated with graded covers rather than evapotranspiration covers, asphalt caps, and multiple-layer caps. Alternatives SW-9 and SW-10 have the highest cost to complete ($102.1 and $108.7 million, respectively) due to the high cost of excavation, importing clean backfill, and off-site disposal of contaminated soil and waste. The costs are the present values calculated using a discount factor of 2.7 percent over a period of 100 years as the costs approach asymptotic levels after 100 years when discounts are applied.

Criteria 8 and 9: State Acceptance and Community Acceptance.

State and community acceptance will be evaluated upon receipt of all Regulatory Agency and community comments on the Proposed Plan

I. Preferred Alternative

The EPA's Preferred Alternative for the LEHR/OCL Site is Alternative SW-6 (VOC "hot spot" Removal, Three On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring) (see Figure 4). Alternative SW-6 would excavate two VOC "hot spot" areas, but leave most soil and waste largely undisturbed. Three CAMUs would be covered with multiple-layer caps to reduce infiltration and leaching of contaminants to groundwater. An existing storm water drainage system would be expanded, groundwater monitored, and institutional controls implemented. Nine buildings would also be removed. Previously unidentified PTW may be present in areas of the land disposal units, but it would be left within the existing footprint of the adjacent CAMU to be consistent with the presumptive remedy for landfills. Wastes excavated for drainage controls will be placed beneath the cap of the adjacent CAMU.

Although most of the soil and waste would remain in place, the Preferred Alternative would remove the VOC "hot spot" areas, in order to reduce the potential for constituents of concern to migrate into groundwater and control their potential migration to surface water. The multiple-layer caps would isolate contaminated soil and waste, limiting human exposure to constituents of concern. In addition, deep-rooted vegetation and deep-burrowing animals would not be able to access contaminated material. Maintenance of the multiple-layer cap and drainage controls, as well as groundwater monitoring, would help maintain the continued protection of human health and the environment.

Based on information available at this time, EPA believes Alternative SW-6 would be protective of human health and the environment and comply with state and federal ARARs. As shown on Table 4, Alternative SW-6 provides the best balance of tradeoffs among the other alternatives with respect to the nine NCP criteria for the evaluation and selection of the remedy at the LEHR/OCL Site. The EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA 121(b): 1) be protective of human health and the environment; 2) comply with ARARs (or justify a waiver); 3) be cost-effective; and 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

As noted previously, the Preferred Alternative (i.e., Alternative SW-6) may be changed in response to public comment or new information.

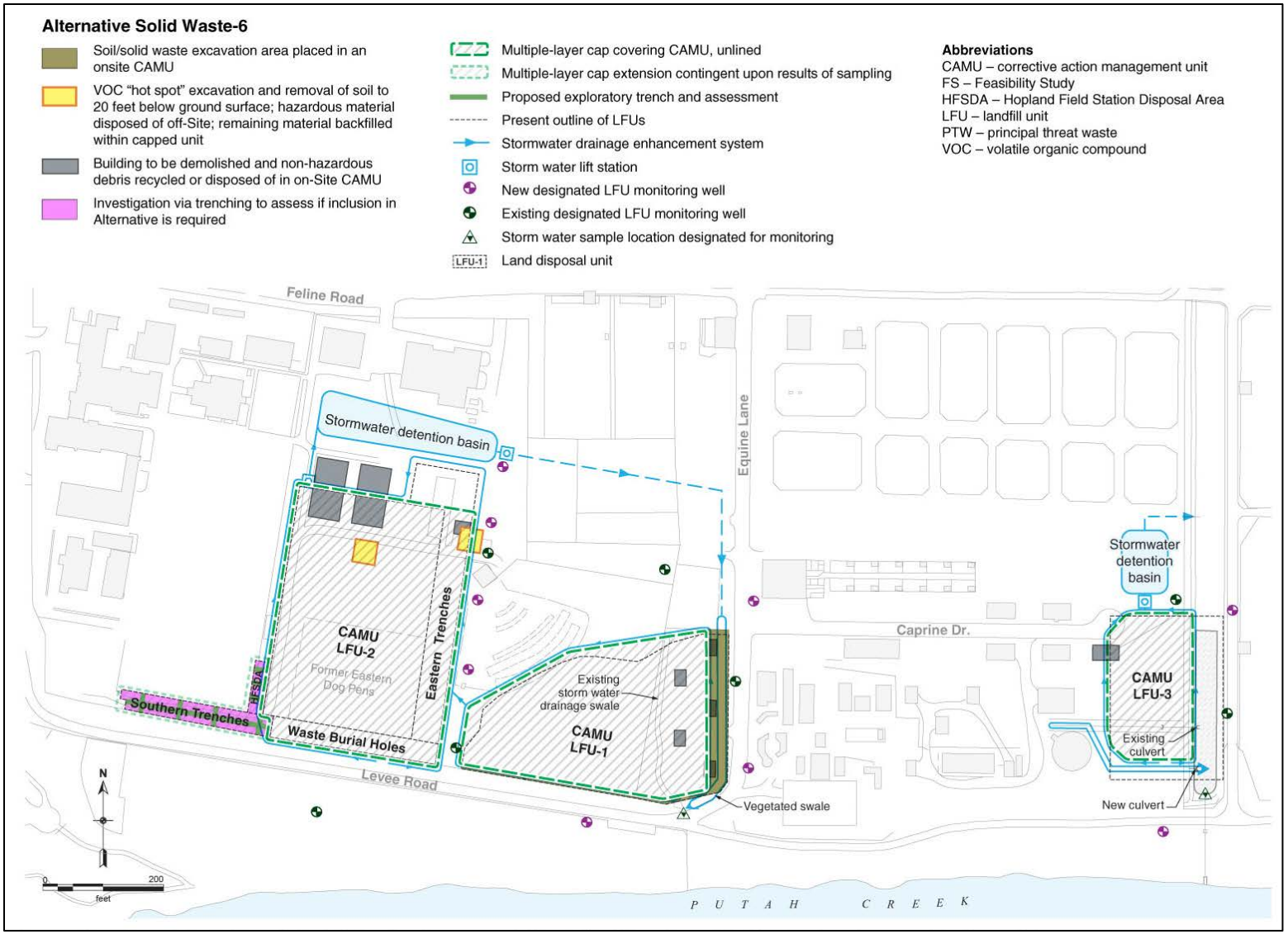

Figure 4: Preferred Alternative - Alternative SW-6 (VOC "Hot Spot" Removal, Three On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring)

COMMUNITY PARTICIPATION

The EPA encourages members of the public to review and comment on this Proposed Plan. To gain a more thorough understanding of the LEHR/OCL Site and the CERCLA activities that have been conducted at the Site, members of the public may visit the information repository to review the administrative record file and other Site-related documents, attend public meetings, and sign-up for the mailing list to receive regular project information.

There are two ways for you to provide your comments on this Proposed Plan:

1. **Public Comment Period: During the public comment period from January 28, 2015 to February 26, 2015 you may use the comment form included with this Proposed Plan to send written comments to David Stensby, Remedial Project Manager, 75 Hawthorne Street, SFD-7-1, San Francisco, CA, 94105, fax to (415) 947-3528, or emailed to: Stensby.David@epa.gov.**

2. **Public Meeting: You may provide written or oral comments during the public meeting on February 10, 2015 beginning at 6:00 p.m. to 8:30 p.m. which will be held in Room 130 in Hoagland Hall at the University of California Davis. A stenographer will be at the meeting to record all public comments. Directions and Parking Permit information for the public meeting on February 10, 2015 are as follows: from 1-80 West, exit north on State Highway 113, exit Hutchison Drive bearing right (pass three traffic signals), turn left on Kleiber Hall Drive and left into the second parking lot (#27). Park in a "regular" space and obtain a parking permit from room 130 in Hoagland Hall to be placed on the dash of your car.**

After the public comment period is over, EPA will review and consider the comments before making a final decision on the remedial alternative to be used at the site. Responses to comments will be documented in the Responsiveness Summary of the Record of Decision. All site-related documents will be available for review in the information repositories and administrative record file as listed below.

INFORMATION REPOSITORIES

The public information repositories for the Site are at the following locations:

Yolo County Public Library
Davis Branch
Reference Desk
315 East 14th Street
Davis, CA
(530) 757-5593

Shields Library
Reserve Desk
UC Davis, 95616
(530) 752-2760

CONTACT INFORMATION

Mr. David Stensby (SFD-7-1)
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105

USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for the University of California, Davis Area, Soil/Solid Waste and Soil Gas at the Laboratory for Energy-related Health Research/Old Campus Landfill Superfund Site, University of California, Davis, California is important to the EPA. Comments provided by the public help EPA select the final remedial alternative for sites undergoing cleanup. EPA will respond to all comments received by the deadline in writing in the Responsiveness Summary section of the Record of Decision.

You may use the space below to write comments. Attach additional pages, if you need additional space for your comments. Comments must be received by February 26, 2015. Send comments to David Stensby, Remedial Project Manager, 75 Hawthorne Street, SFD-7-1, San Francisco, CA 94105, fax to (415) 947-3520, or email to stensby.david@epa.gov.

If you would like to be on the mailing list to receive information about the environmental restoration activities at Laboratory for Energy-related Health Research/Old Campus Landfill Superfund Site, please provide you name and address below.

Name _____

Address _____

City _____ **State** _____ **Zip** _____

☐ **Yes, add me to the mailing list**

GLOSSARY

Administrative Record: A collection of all documents considered in selecting a remedy for a CERCLA site.

Applicable or Relevant and Appropriate Requirements (ARARs): Federal, state, and local environmental laws, regulations, and standards determined to be legally applicable or relevant and appropriate to removal or remedial actions at a CERCLA site. The NCP requires compliance with all state or federal ARARs at a Superfund site unless they are waived.

Cancer risk: The probability that an individual will develop cancer from direct exposure to chemicals classified as human carcinogens.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): The federal law (also referred to as the "Superfund" law) that established a program to identify hazardous waste sites and procedures for cleaning up these sites to protect human health and the environment, and to evaluate damages to natural resources [refer to 42 U.S. Code Chapter 103]. The law was amended, by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the Small Business Liability Relief and Brownfield's Revitalization Act of 2002.

Constituent of Concern: A metal, **organic chemical**, or radioactive constituent that is present in soil, sediment, soil gas, ambient air or groundwater at concentrations greater than those considered safe for humans and/or ecological receptors.

Corrective Action Management Unit (CAMU): An area within a facility that is used to consolidate, treat, store, and/or dispose of hazardous and non-hazardous waste in order to implement corrective action and site cleanup. CAMU-eligible wastes are solid and hazardous wastes and media (e.g., soil and sediment) and debris that are managed to implement cleanup [refer to 40 Code of Federal Regulations 264.552(a)].

De minimus: Minimal, insignificant, or negligible.

Ecological Receptors: Any living organisms other than humans, the habitat which supports such organisms or natural resources which could be adversely affected by releases of environmental contaminants.

Evapotranspiration Cover: A soil cover that limits the amount of water entering landfill wastes by evaporation and using plants to remove the moisture from the soil cover and release the water into the atmosphere.

Exposure pathway: The means by which humans and ecological receptors come into contact with (or get exposed to) a substance (e.g., inhalation of contaminated dust or drinking contaminated groundwater).

Exposure scenarios: A set of facts, assumptions, and inferences about how exposure takes place that aids the risk assessor in evaluating, estimating, or quantifying exposures.

Ex situ treatment: A form of treatment that takes place above ground after the removal of the contamination or contaminated media from where it is buried (e.g., through excavation).

Feasibility Study (FS): The second of two major studies that must be completed before a decision can be made about how to clean up a site. (An RI is the first step; it identifies the nature and extent of contamination at the site and the associated risk.) The FS uses the information developed in the RI to establish remedial objectives and goals and to screen and evaluate possible remedial technologies that are combined into proposed remedial alternatives for cleaning up a site.

Groundwater: Underground water that fills spaces between particles of soil, sand, and gravel or openings in rocks to the point of saturation. Groundwater can be used as a source of drinking water, for industrial uses, or for agricultural irrigation.

Hazard index: For human health, the hazard index is a calculated value used to represent a potential non-cancer health hazard for more than one chemical or exposure pathway. The hazard index is the sum of the hazard quotient which is the ratio of a contaminant concentration divided by the safe exposure level. A hazard index value of 1.0 or less is considered an acceptable exposure level. If the hazard index exceeds 1, exposure to contaminants may pose non-cancer health hazards. Non-cancer health hazards are contaminant-dependent, but may include kidney disease, headaches, dizziness, and anemia. For more information, go to ToxFAQs at www.atsdr.cdc.gov.

Hot spots: Area with contaminated soil where concentrations of certain chemicals are much higher than (such as 10 or 100 times) background levels and the levels considered safe for humans and/or ecological receptors.

Human health risk assessment: The estimate of potential harmful effects humans may experience as a result of exposure to chemicals.

Hydrostratigraphic unit: A formation, part of a formation, or groups of geologic formations in which there are similar groundwater flow characteristics allowing for grouping into groundwater bearing zones or confining zones (i.e., aquitards).

Institutional Controls: Legal and administrative documents and processes to limit human exposure to contaminated waste, soil, or groundwater. These documents and processes may include deed restrictions, covenants, easements, laws, and regulations administered by the State. Also called land use controls (LUCs).

Leachate: Water originating at the surface that has gained dissolved chemicals and suspended solids after passing through buried waste or other subsurface contamination.

Maximum Contaminant Level: The highest level of a contaminant that is allowed in drinking water. Maximum contaminant levels applicable to the site are set by the United States Environmental Protection Agency and/or the State of California.

Milligram per kilogram (mg/kg): Unit used to describe concentrations of chemicals in soil or sediment. One milligram per kilogram is approximately equal to one part per million. A part per million is equivalent to about 4 drops in 55 gallons or approximately 32 seconds in one year.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The NCP is the set of regulations that establishes the framework for responses to oil spills and hazardous substances.

National Priorities List (NPL): The NPL is the list of is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

Organic chemicals: Chemicals or groups of chemicals containing carbon that may be present in the natural environment but are usually changed and concentrated to create various products (such as cleaning solvents or fuels). Soil and groundwater can be contaminated if such products are spilled on the ground or buried for disposal.

Picocurie per gram (pCi/g): Unit used to describe activity concentrations of radioactive constituents in soil or sediment. One picocurie is equal to one trillionth of a curie.

Preferred remedial alternative: The remedial alternative selected by the EPA, in conjunction with the other regulatory agencies, based on the evaluation of remedial alternatives presented in the FS.

Preliminary remediation goal: A concentration established for a given constituents of concern as a remedial benchmark for protectiveness of human health and the environment under a specific scenario of land use (e.g., commercial, industrial, or residential).

Presumptive remedy: Preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation.

Principal Threat Waste (PTW): Waste that is considered highly toxic or highly mobile or would potentially present a risk to human health or the environment in the event of exposure.

Receptors: People, plants or wildlife that may be exposed to contaminated soil, sediment, groundwater, or soil gas.

Record of Decision (ROD): The document that sets forth the basis for EPA's decision to select a particular remedial alternative for implementation at a CERCLA site. The ROD is based on information from the RI, FS, and other reports, and on public comments and community concerns.

Remedial Action: An environmental cleanup conducted based on a ROD that involves actions to contain, collect, or treat hazardous wastes (or a combination of all three) to protect human health and the environment.

Remedial Action Objectives (RAOs): Statements that describe the goals of a cleanup goal in terms of the protection of one or more receptors (e.g., people, plants, or wildlife) from one or more chemicals in a specific medium (such as soil, groundwater, or air) at a site.

Remedial Investigation (RI): One of two major studies that must be completed before a decision can be made about how to clean up a site. The RI is conducted to evaluate the nature and extent of contamination at the site and the associated risk. (The FS is a second study that is only conducted when the RI recommends development of cleanup options for a site.)

Risk: The likelihood or probability that a hazardous substance released to the environment will cause adverse effects on exposure to human or biological receptors.

Risk assessment: An assessment of the likelihood or probability that a hazardous chemical, when released to the environment, will have negative effects on exposed humans or ecological receptors.

Risk management range: The risk management range as derived from the NCP is used for making risk management decisions. The default range used by EPA is considered to represent an excess lifetime cancer risk to an individual between 1 in 10,000 (1x10-4) and 1 in 1,000,000 ($1x10^{-6}$).

Screening-level ecological risk assessment: An analysis of the potential ecological effects on plants and animals caused by exposure to hazardous substances released from a site.

Soil gas: The air between soil particles that may be impacted by contaminants that have vaporized in the soil.

Soil solidification/stabilization: Mixing contaminated soil with a material (like cement) so that contaminants cannot leach from it.

Solid waste: Materials found in a landfill. This includes typical municipal wastes like household and office trash and, in the case of the LEHR/OCL Site, laboratory wastes. Solid wastes in landfills are typically mixed with and/or covered with soil.

Vapor Intrusion: The migration of volatile organic compounds from the subsurface to overlying buildings.

Volatile organic compound (VOC): An organic (carbon containing) compound that evaporates readily at room temperature. VOCs are found in industrial solvents commonly used in dry cleaning, metal plating, and machinery degreasing operations.

Table 1: Estimated Cancer and Non-cancer Risks (0 to 10 feet bgs) and Preliminary Remediation Goals, Soil and Waste

Land Disposal Unit/Constituent	Increased Number of Cancer and Non-cancer[1] Risks Without Soil Cleanup	Proposed Preliminary Remediation Goal (mg/kg unless noted)[2]
Eastern Trenches		
Carbon-14	2.7 in 10,000,000	0.13 pCi/g
Tritium (Hydrogen-3)	1.4 in 1,000,000	1.2 pCi/g
Landfill Unit No. 1		
Arsenic	2.5 in 100,000	9.6
Benzo(a)pyrene	1 in 1,000,000	0.015
Carbon-14	2.7 in 10,000,000	0.13 pCi/g
Copper	NA[3]	60
Lead	NA[4]	80
Selenium	NA[3]	1.2
Landfill Unit No. 2	2.7 in 10,000,000	0.13
Benzo(a)anthracene	1 in 1,000,000	0.15
Benzo(a)pyrene	1 in 1,000,000	0.015
Benzo(b)fluoranthene	1 in 1,000,000	0.15
Cadmium	NA[3]	0.5
Carbon-14	2.7 in 10,000,000	0.13 pCi/g
Cesium-137	1 in 1,000,000	0.062 pCi/g
Lead	NA[4]	80
Aroclor 1260	1 in 1,000,000	0.22
Strontium-90[5]	1 in 1,000,000	0.24 pCi/g
Potassium-40[5]	1.2 in 10,000	14 pCi/g
Landfill Unit No. 3		
Barium	NA[3]	260
Cadmium	NA[3]	0.5
Carbon-14	2.7 in 10,000,000	0.13 pCi/g
Cesium-137	1 in 1,000,000	0.062 pCi/g
Copper	NA[3]	138
Lead	NA[4]	80
Manganese	1.0[1]	1,800
Aroclor 1260	1 in 1,000,000	0.22
Strontium-90	1 in 1,000,000	0.24 pCi/g
Southern Trenches		
Carbon-14	1 in 1,000,000	0.48 pCi/g
Waste Burial Holes		
Carbon-14	6.7 in 10,000,000	0.32 pCi/g
Cesium-137	1 in 1,000,000	0.062 pCi/g
Naphthalene	1 in 1,000,000	3.6
Strontium-90	1 in 1,000,000	0.24 pCi/g
Tritium (Hydrogen-3)	1.4 in 1,000,000	1.2

Notes:

[1] Risk associated with non-cancer hazard.

[2] The source of the proposed preliminary remediation goals is presented in Section 3 (Remedial Action Objectives and Applicable or Relevant and Appropriate Requirements), Table 3-6 (Protectiveness of Cleanup Goals for Human Health Cancer Risk), Table 3-7 (Protectiveness of Cleanup Goals for Human Health Non-Cancer Hazards), and Appendix D (Applicable or Relevant and Appropriate Requirements) of the FS Report.

[3] The groundwater impact designated concentration levels, as presented in Appendix A (Feasibility Study Data Gaps Technical Report) of the FS Report.

[4] The non-cancer risk associated with lead is not presented as it is based on blood-lead levels.

[5] Risk associated with constituents at 10-30 feet bgs.

Acronyms:

bgs – below ground surface
mg/kg – milligrams per kilogram
NA – Not applicable
pCi/g – picocuries per gram

Table 2: Total Cancer and Non-cancer Risks to Human Health based on Findings from the 2006 Risk Assessment

Land Disposal Unit/Receptor	Total Cancer Risk[1] Below, Within, or Above the Target Risk Management Range[2]	Cancer Risk[3] from Chemical Exposure	Cancer Risk[3] from Radionuclide Exposure	Non-cancer Risk (Hazard Index)
Eastern Trenches				
Hypothetical Future Resident Child	Above	1 in 10,000	6 in 100,000	2.4
Hypothetical Future Resident Adult	Above	1 in 10,000	2 in 10,000	0.71
On-Site Researcher - Indoor	Within	4 in 1,000,000	1 in 100,000	0.014
On-Site Researcher - Outdoor	Within	5 in 1,000,000	2 in 100,000	0.029
Construction Worker	Within	6 in 10,000,000	4 in 1,000,000	0.095
Trespasser	Within	7 in 10,000,000	2 in 1,000,000	0.016
Landfill Unit No. 1				
Hypothetical Future Resident Child	Above	4 in 10,000	5 in 100,000	11
Hypothetical Future Resident Adult	Above	6 in 10,000	2 in 10,000	3.3
On-Site Researcher - Indoor	Within	2 in 1,000,000	2 in 100,000	0.014
On-Site Researcher - Outdoor	Within	5 in 1,000,000	7 in 100,000	0.029
Construction Worker	Within	2 in 1,000,000	4 in 1,000,000	0.37
Trespasser	Within	6 in 10,000,000	2 in 1,000,000	0.016
Landfill Unit No. 2				
Hypothetical Future Resident Child	Above	4 in 10,000	6 in 100,000	29
Hypothetical Future Resident Adult	Above	5 in 10,000	2 in 10,000	7.9
On-Site Researcher - Indoor	Within	1 in 100,000	2 in 100,000	0.014
On-Site Researcher - Outdoor	Within	5 in 1,000,000	8 in 100,000	0.029
Construction Worker	Within	2 in 1,000,000	5 in 1,000,000	0.31
Trespasser	Within	6 in 10,000,000	3 in 1,000,000	0.016
Landfill Unit No. 3				
Hypothetical Future Resident Child	Above	4 in 10,000	6 in 100,000	60
Hypothetical Future Resident Adult	Above	6 in 10,000	2 in 10,000	16
On-Site Researcher - Indoor	Within	2 in 1,000,000	2 in 100,000	0.024
On-Site Researcher - Outdoor	Within	4 in 1,000,000	7 in 100,000	0.054
Construction Worker	Within	2 in 1,000,000	4 in 1,000,000	0.93
Trespasser	Within	6 in 10,000,000	2 in 1,000,000	0.025
Southern Trenches				
Hypothetical Future Resident Child	Within	9 in 100,000	5 in 100,000	2.3
Hypothetical Future Resident Adult	Above	1 in 10,000	2 in 10,000	0.68
On-Site Researcher - Indoor	Within	2 in 1,000,000	2 in 100,000	0.011
On-Site Researcher - Outdoor	Within	4 in 1,000,000	7 in 100,000	0.024

Land Disposal Unit/Receptor	Total Cancer Risk[1] Below, Within, or Above the Target Risk Management Range[2]	Cancer Risk[3] from Chemical Exposure	Cancer Risk[3] from Radionuclide Exposure	Non-cancer Risk (Hazard Index)
Construction Worker	Within	6 in 10,000,000	4 in 1,000,000	0.089
Trespasser	Within	5 in 10,000,000	2 in 1,000,000	0.013
Waste Burial Holes				
Hypothetical Future Resident Child	Within	1 in 10,000	5 in 100,000	2.6
Hypothetical Future Resident Adult	Above	1 in 10,000	2 in 10,000	0.78
On-Site Researcher - Indoor	Within	2 in 1,000,000	2 in 100,000	0.013
On-Site Researcher - Outdoor	Within	5 in 1,000,000	7 in 100,000	0.028
Construction Worker	Within	7 in 10,000,000	4 in 1,000,000	0.10
Trespasser	Within	6 in 10,000,000	2 in 1,000,000	0.015

Notes:
[1] Total cancer risk as ILCR.
[2] The target risk management range is 1x10-4 to 1x10-6 (1 in 10,000 to 1 in 1,000,000)
[3] Cancer risk as the Theoretical Upper-Bound ILCR.

Acronyms:
ILCR – Incremental Lifetime Cancer Risk

Table 3: Components included in the Remedial Alternatives

Components included in the Remedial Alternatives	SW-2	SW-3	SW-4	SW-5	SW-6[1]	SW-7	SW-8	SW-9	SW-10
Planning/Oversight/General									
Work Planning	✓	✓	✓	✓	✓	✓	✓	✓	✓
Health & Safety	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construction Quality Assurance/Quality Control Program	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construction Site Environmental Controls		✓	✓	✓	✓	✓	✓	✓	✓
Materials Management Plan		✓	✓	✓	✓	✓	✓	✓	✓
Pre-Remediation									
Land Surveying	✓	✓	✓	✓	✓	✓	✓	✓	✓
Decontamination Facilities	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pre-Construction Biological Survey		✓	✓	✓	✓	✓	✓	✓	✓
Elderberry Shrub Cluster Relocation		✓	✓	✓	✓	✓	✓	✓	✓
Data Gap Investigation	✓	✓	✓	✓	✓				
Building Decommissioning and Demolition; Replacement and Relocation									
-Cobalt-60 Annex		✓							
-Animal Buildings X-1 through X-5, Geriatrics Building No. 1 (H-292), Geriatrics Building No. 2 (H-293), Storage Building W-3, and the Cobalt-60 Annex			✓	✓	✓	✓	✓	✓	✓
Decommissioning of Groundwater Monitoring Wells			✓	✓	✓	✓	✓	✓	✓
Remediation – Excavation, Waste Segregation and Disposal, Backfill									
Area Excavation		✓	✓	✓	✓	✓	✓	✓	✓
PTW Excavation		✓	✓	✓		✓	✓	✓	✓
Additional Exploratory Trenches									
-Trenches excavated in the Eastern Trenches		✓	✓	✓					
-Trenches excavated in LFU-1 and LFU-2		✓	✓	✓		✓			
-Trenches excavated in LFU-3		✓	✓	✓					
Volatile Organic Compound “Hot Spot” Removal									
-Non-hazardous material backfilled on-Site, except for eastern half of the Eastern Trenches VOC “hot spot,” which would be backfilled with clean fill		✓	✓	✓	✓	✓	✓		
-Non-hazardous material sent off-Site for disposal, VOC “hot spots” backfilled with clean fill								✓	✓
Confirmation Sampling	✓	✓	✓	✓	✓	✓	✓	✓	✓
Segregation, Stockpiling, and Characterization of Excavated Material	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ex situ Treatment	✓	✓	✓	✓	✓	✓	✓	✓	✓
On-Site Disposal	✓	✓	✓	✓	✓	✓	✓	✓	
Off-Site Disposal	✓	✓	✓	✓	✓	✓	✓	✓	✓
Backfill	✓	✓	✓	✓	✓	✓	✓	✓	✓
Remediation - Capping									
Establish Graded Cover		✓							
Consolidate Waste and Evapotranspiration Cover			✓						
Consolidate Waste and Asphalt Cap				✓					
Consolidate Waste and Multiple-Layer Cap					✓	✓	✓	✓	

Components included in the Remedial Alternatives	SW-2	SW-3	SW-4	SW-5	SW-6[1]	SW-7	SW-8	SW-9	SW-10
Levee Easement Setback		✓	✓	✓	✓	✓	✓	✓	
Landfill Liner							✓		
Drainage Controls									
LFU-3 Concrete-Lined Drainage Channel Sealed		✓							
LFU-3 Concrete-Lined Drainage Channel Demolition/Reconstruction -Portion of concrete-lined drainage channel demolished, concrete re-established after excavation			✓	✓					
LFU-3 Concrete-Lined Drainage Channel -Entire concrete-lined drainage channel demolished, replaced with a vegetated drainage channel after excavation. Erosion controls would be installed as appropriate, and may include geotextiles and/or rip-rap						✓	✓	✓	✓
LFU-3 East-West-Trending Drainage Ditch Relocation		✓	✓	✓	✓	✓	✓	✓	✓
LFU-1 Concrete-Lined Drainage Channel		✓							
LFU-1 Drainage/Vegetated Swale			✓	✓	✓	✓	✓	✓	✓
Storm Water Collection and Conveyance System		✓	✓	✓	✓	✓	✓		
Storm Water Lift Station at LFU-2/Waste Burial Holes/Eastern Trenches		✓	✓	✓	✓	✓	✓		
Storm Water Lift Station at LFU-3		✓	✓	✓	✓				
Extended Detention Basin		✓	✓	✓	✓	✓	✓		
Post-Remediation									
Cover/Cap Monitoring and Maintenance		✓	✓	✓	✓	✓	✓	✓	
Drainage Controls Monitoring and Maintenance		✓	✓	✓	✓	✓	✓	✓	✓
Groundwater Monitoring Well Installation	✓	✓	✓	✓	✓	✓	✓	✓	✓
Groundwater and Storm Water Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓
Land Use/ Institutional Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
Five-Year Reviews	✓	✓	✓	✓	✓	✓	✓	✓	✓

Notes:
[1] This alternative has been modified since it was originally presented in the FS Report to align it more closely with the presumptive remedy for landfills.

Acronyms:
CAMU – Corrective action management unit
LFU – Landfill unit
O&M – Operations and maintenance
PTW – Principal threat waste
VOC – Volatile organic compound

Table 4: Estimated Construction Time and Costs for the Remedial Alternatives

Remedial Alternative	Total Excavated Volume (LCY)	Time until RAOs are Met	Capital Costs	Total O&M Costs	Periodic Costs	Approximate Cost
SW-1: No Action/No Further Action	0	Not Applicable	$0	$0	$0	0
SW-2: Institutional controls and Groundwater Monitoring	332	One Construction Season[1]	$318,780	$6,018,220	$173,297	$6,510,297
SW-3: VOC "Hot Spot" Removal, Three On-Site CAMUs with Graded Covers, Institutional Controls, Drainage Controls, and Groundwater Monitoring	5,943	One Construction Season[1]	$6,463,826	$6,921,681	$185,523	$13,615,089
SW-4: VOC "Hot Spot" Removal, Three On-Site CAMUs with Evapotranspiration Covers, Institutional Controls, Drainage Controls, and Groundwater Monitoring	19,882	One Construction Season[1]	$11,421,744	$6,893,510	$185,523	$18,650,222
SW-5: VOC "Hot Spot" Removal, Three On-Site CAMUs with Asphalt Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring	19,882	One Construction Season[1]	$12,943,460	$7,764,868	$185,523	$21,126,868
SW-6: VOC "Hot Spot" Removal, three On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring[2]	9,630	One Construction Season[1]	$9,487,946	$7,029,624	$185,523	$16,907,140
SW-7: VOC "Hot Spot" Removal, Two On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring	40,349	One Construction Season[1]	$13,836,609	$6,842,252	$181,448	$20,860,309
SW-8: VOC "Hot Spot" removal, One On-Site Lined CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Controls, and Groundwater Monitoring	274,704	Two Construction Seasons[1]	$26,239,041	$6,948,273	$181,448	$33,368,762
SW-9: Excavate and Dispose of Waste Off-Site, Waste Burial Holes CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Controls, and Groundwater Monitoring	117,158	Two Construction Seasons[1]	$95,979,224	$5,990,304	$173,297	$102,142,825
SW-10: Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Controls, and Groundwater Monitoring	123,386	Two Construction Seasons[1]	$102,950,982	$5,561,706	$173,297	$108,685,985

Notes:

[1] Institutional controls, such as signage and land use controls, would be in effect until cleanup goals approved in the ROD are achieved.

[2] This alternative has been modified since it was originally presented in the FS Report to align it more closely with the presumptive remedy for landfills.

Acronyms:
CAMU – Corrective action management unit
LCY – Loose cubic yards
O&M – Operations and maintenance
VOC – Volatile organic compound

Table 5: Comparative Analysis of Alternative for the LEHR/OCL Site

Remedial Alternative	Overall Protection of Human Health and Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume via Treatment[1]	Short-term Effectiveness	Implementability	Approximate Cost ($ Millions)
SW-1: No Action/No Further Action	No	No	⊕	⊕	⊕	●	0
SW-2: Institutional Controls and Groundwater Monitoring	No	No	⊕	⊕	⊕	●	$6.5
SW-3: VOC "Hot Spot" Removal, Three On-Site CAMUs with Graded Covers, Institutional Controls, Drainage Controls, and Groundwater Monitoring	No	No	◔	⊕	⊕	◑	$13.6
SW-4: VOC "Hot Spot" Removal, Three On-Site CAMUs with Evapotranspiration Covers, Institutional Controls, Drainage Controls, and Groundwater Monitoring	No	No	◑	⊕	◕	◕	$18.5
SW-5: VOC "Hot Spot" Removal, Three On-Site CAMUs with Asphalt Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring	Yes	Yes	◑	⊕	●	◕	$21.1
SW-6: VOC "Hot Spot" Removal, Three On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring	Yes	Yes	◑	⊕	●	◕	$16.9
SW-7: VOC "Hot Spot" Removal, Two On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Controls, and Groundwater Monitoring	Yes	Yes	◑	⊕	◕	◑	$20.9
SW-8: VOC "Hot Spot" Removal, One On-Site Lined CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Controls, and Groundwater Monitoring	Yes	Yes	◕	⊕	◕	◑	$33.4
SW-9: Excavate and Dispose of Waste Off-Site, Waste Burial Holes CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Controls, and Groundwater Monitoring	Yes	Yes	●	⊕	◑	◑	$102.1
SW-10: Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Controls, and Groundwater Monitoring	Yes	Yes	●	⊕	◑	◑	$108.7

Notes:

⊕ ◔ ◑ ◕ ●

Not acceptable → More acceptable

[1] Alternatives SW-1 and SW-2 do not include the use of treatment technologies. Alternatives SW-3 through SW-10 may include ex situ treatment (e.g., soil solidification/stabilization) of a fraction of the hazardous and mixed waste to render it non-hazardous prior to off-site disposal.